SIXTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CVI. NUMBER 6.

NEW YORK, FEBRUARY 10, 1912

15 CENTS $3.00 A YEAR

The photographic gun.

The gun's work.

A "Photogrammetric Gun" for Making Surveys in a Balloon

A New Use for Good Marksmanship

IN order to reconstruct an object, in its true dimensions, form and inclination to the horizon, from photographs taken from a balloon, three points of the object must be known. Photographs used for surveying and charting are usually made with a photographic theodolite, the axis of which can be set at a known inclination to the vertical by means of levels. In this case two photographs suffice for the reconstruction of an object or landscape. In balloon photography, however, the usual methods of directing the camera and ascertaining its inclination to the vertical cannot be employed.

Many years ago Prof. Finsterwalder of Munich invented, as he tells us in the annals of the Munich Verein für Luftschiffahrt (1905), an instrument, which he calls a "photogrammetric gun," that obviates this difficulty. The accompanying photograph, furnished by Freiherr von Bassus, the constructor of the gun, shows that it consists of a camera attached at an angle of about 45 degrees to a gunstock, provided with a sensitive spherical level, which is seen by reflection in a suitably arranged mirror when the gun is raised to the shoulder. At the moment when the air bubble of the level, which dances with the swaying of the balloon, is exactly circumscribed by the circular reference mark, the camera shutter is released by a mechanism attached to the gunstock and an instantaneous photograph of the landscape is taken.

The spherical level is so placed relatively to the camera that the upper and lower edges of the plate are horizontal when the bubble occupies the marked circle. This adjustment is made by attaching linear levels to the camera and correcting the setting of the spherical level if necessary. The plate is also set at a known inclination to the horizon, about 45 degrees, at the moment of exposure, by the observation of the spherical level.

The photogrammetric gun was originally devised for the purpose of making approximately oriented photographs of a landscape, from which horizontal distances could be obtained by simple means with sufficient accuracy for military purposes. It was soon proved that an expert marksman could set the level very accurately, despite the swaying of the balloon, but it was uncertain whether this instantaneous setting of the moving bubble agreed with its true position at rest. It was impracticable to decide this point by using a plumb line in the swaying balloon, but comparison of the photographs with leveling maps of the same fields showed that the setting of the moving bubble was accurate to the limit imposed by the small scale (1 to 25,000) of the maps, that is, to about 0.2 degree.

Meanwhile it had been found possible to reconstruct an object or landscape very accurately, on a scale of 1 to 5,000, without any reference to the plumb line, from two balloon photographs taken from different view points. If the vertical lines deduced from the indications of the level of the instrument at the two exposures are drawn on such a reproduction, the two lines should be parallel if the bubble occupied its true zero position at each exposure. The application of this test showed that the indications of the level could be relied on to within 0.1 degree.

Still more severe tests are furnished by the comparison of details of the reconstruction with the corresponding parts of good maps and of the real object or landscape. For example, a plain should show no appreciable differences in elevation and a stream should never be represented as flowing up-hill. By means of such comparisons it has been ascertained that the moving bubble of the level gives the position of the vertical line to within about 0.05 degree, which is approximately equal to the degree of precision with which the position of the bubble can be observed.

In this way the practical value of the new method of balloon photogrammetry, which was already known to rest on a sound theoretical basis, has been fully established. This method is distinguished from the old methods by its almost complete elimination of calculation and by its apparent susceptibility to additional and extensive mechanical simplification.

Apart from its immediate utility, the device here described is interesting as another example of a general tendency which is characteristic of modern civilization: the extension of the limitations of our unaided senses by the assistance of artificial accessories which themselves fulfill functions analogous to those of our sense organs.

Here a camera, in all essentials a copy of the eye, is used to supplement our rather crude natural estimate of distances and orientation. This is what has made evolution progress with giant strides in the modern civilized community; we are no longer dependent upon the gradual development of new organs and faculties by slow physiological processes of accommodation working through the phenomena of heredity and variation (or perhaps we should say mutation), but have learned to produce, as the occasion arises, and at comparatively short notice, such artificial auxiliaries as the exigencies of our time demand.

And, be it noted, the "artificial sense organs" have the advantage over our natural body, that they are not subject to the same periodic destruction by death, but in most cases continue to serve another individual long after the first owner has ceased to live.

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, FEBRUARY 10, 1912

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary and Treasurer; all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter

Subscription Rates

Subscription one year $3.00

Postage prepaid in United States and possessions Mexico, Cuba, and Panama

Subscriptions for Foreign Countries, one year, postage prepaid. 4.50

Subscriptions for Canada, one year, postage prepaid. 3.75

The Scientific American Publications

Scientific American (established 1845) . . . . per year. $3.00

Scientific American Supplement (established 1876) . " " 5 00

American Homes and Gardens . . . . " " 3.00

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A National Peril

WE call attention to the strong warning of Secretary Meyer against the movement in Congress to defeat the bill for the construction this year of the two battleships called for by the Navy Department. The Secretary is perfectly within the facts when he states that one dreadnought is capable, unaided, of defeating and sinking several battleships of the "Indiana," "Iowa," and "Kentucky" classes. In another year four of our older battleships will become "non-effective," and others, in their turn, must be stricken from the effective list. These two additional ships do not, therefore, constitute an addition—they represent a conservative policy of merely maintaining our fleet at its present standard. Relatively we are falling behind the other naval powers. To maintain our present relative strength we should be building four dreadnoughts each year. England this year adds five, Germany four capital ships, and Japan last year authorized five such. If we cease building, we drop quickly to fourth or fifth place, and this at a time when our wealth and population are increasing by leaps and bounds. The navy has to protect an enormous coastline—to say nothing of Porto Rico, Hawaii and the Philippines. We have guaranteed the neutrality of the Panama canal—we still stand for the inviolability of the Monroe Doctrine.

Have our members of Congress so soon forgotten the frantic outcry of various cities on our coastline for warships to be stationed at their doors during the Spanish war, and this at the very time when these ships were badly needed by Sampson and Schley for crushing Cervera on the high seas?

Sub-soiling by High Explosives

IN the last agricultural issue of the SCIENTIFIC AMERICAN we described the many uses to which high explosives are being put on the farm. Among these, mention was made of the use of dynamite for loosening up the sub-soil and so permitting the crops to root themselves more deeply, and reach those lower strata which are untouched by the ordinary methods of cultivation by the plow and the harrow. At the present writing it would seem that, among the many improvements which mark the new agriculture, this is destined to hold a position of ever-increasing importance. Practised first, we believe, by a Southern farmer, the method of plowing with a stick of dynamite showed such immediate and surprising results that the question of its extension was merely one of publicity. The increase in the crops, resulting from what might be called high-explosive plowing, was so immediate, so large, and, what is most important of all, was so out of proportion to the cost of powder, that there was every inducement for the manufacturers to start a campaign of education among the farmers and present to them certain well-established facts as to what had been accomplished. We have secured from one of the half dozen or more manufacturers who are giving special attention to this matter a statement of the amount of high explosive which they have supplied to the farmers during the past five years. Starting with half a million pounds in 1908, there was an increase in the sales of fifty per cent in 1909. In the following years the total amount disposed of has annually doubled; and the indications for the present year are that the total amount which will be shipped to the farmers by this one concern will be about five million pounds.

The Romance of Engineering

THE wide popularity of the writings of Jules Verne proves that, although engineering is supposed to be far removed from the field of romance and speculation, this great art is capable of being so handled by a writer who combines a free imagination, a facile pen, and, of course, a fairly broad knowledge of science and art, as to become absorbingly fascinating. The school of Jules Verne has its later representatives in Kipling and Wells, who both possess, in a rare degree, the faculty of writing technical romances and even indulging in technical prophecy, without overstepping the line which separates the sublime from the ridiculous.

But, after all, is it necessary to go to Jules Verne when the day-by-day happenings in the field of engineering supply us with situations as replete with the wonderful and the dramatic as any that have been conjured up by the writers of technical fiction? Let us put that statement to the test. During the first week of the present year, when the North Atlantic Fleet was making its way south for Guantanamo, Cuba, a storm of extreme fury burst upon the fleet, working swift damage, disabling many ships, and causing the admiral to bid each disabled vessel make its way to the nearest port of refuge. During the greater part of the gale an official at Washington was in touch with every battleship and cruiser in the fleet. Sitting in the quiet of his office, he learned hour by hour how each vessel fared, where she was, and how her course was laid. If a heavy sea came aboard, smashing boats and carrying away deck structures, the facts were known within the hour and laid upon his desk in a typewritten statement. He was able to converse with the captain of each ship, advise with him; and in short, through the wonderful eyes and ears of the wireless, he was in a position, had he so wished, to control and coordinate the movements of the scattered fleet with a surer knowledge of their position and condition than the admiral himself. The most daring dream of Jules Verne never carried him so far into the seemingly miraculous as that!

The wonders of yesterday become the commonplace facts of to-day; and the engineer has so surfeited the public with achievements of daring and magnitude that the greatest works excite a passing, if not a languid, interest. It was only the other day that the Mayor of this city, standing a thousand feet below the surface of the Hudson River, set off the final blast that opened from shore to shore through the solid rock, a huge inverted drinking-supply conduit, which is big enough for a railroad train to run through. And this will form merely one link in a ninety-mile-long subterranean aqueduct for supplying New York's drinking water.

The people of the United States are so much interested in the engineering problems of the Panama canal, that they overlook some other contemporary feats of engineering, which equal those at the Isthmus in difficulty and occasionally surpass them in daring and originality. When the engineers of the Catskill aqueduct reached the Hudson River and sank their test borings in its bed, they found to their dismay that below its waters was a deep geological gorge, filled to a depth of 800 feet with loose glacial drift. So they determined to blast out a tunnel below the gorge, going down until they reached absolutely solid rock that was impervious to water. They found that they would have to sink to a level over 1,100 feet below the surface of the river—and this they have done. So when the work is opened, an artificial subterranean river of pure mountain water nearly 100 miles in length will flow from the Catskills to New York. When it reaches the Hudson, at an elevation of 400 feet above the river, it will make a sheer drop of 1,500 feet, flow horizontally for over 3,000 feet at a depth of 1,100 feet below the river and within walls on each square foot of which the water will exert a pressure of 46½ tons, and then rise vertically through a height of 1,500 feet to the "flow-line" level of the aqueduct. It is a great work, boldly conceived and most successfully accomplished.

The Romans were great builders of aqueducts; but they never worked on such a scale as this. There was no necessity. Had Rome called for a daily supply of 500,000,000 of gallons, its engineers would, doubtless, have found a way—even though they had neither dynamite nor diamond drills.

Parsons on the Steam Turbine

WE have before us a copy in book form of the Rede lecture, recently delivered by Sir Charles Parsons, who chose for his subject the steam turbine.

It is of interest to note that about the year 1837 several simple reaction turbines, similar in principle to Hero's steam wheel, were made by Avery, at Syracuse, New York, and by Wilson, at Greenock, Scotland, for driving circular saws and cotton gins. Steam was introduced at the center of a hollow shaft, and by the reaction of jets at the extremities caused rotation. They operated, but were inefficient. Then De Laval, in 1888, utilized the energy of expansion by causing the steam to impinge from a trumpet-shaped jet upon the blades of a wheel.

In 1884 Parsons dealt with the turbine problem on a different plan from that of De Laval. Realizing that moderate surface velocities and speeds of rotation were necessary, he decided to split up the falling pressure of the steam into small fractional expansions over a large number of turbine wheels placed in series. He thus avoided the enormous velocities of the De Laval turbine, and he proved in later years that the moderate speed turbine suffices for the highest economy. This principle of "compounding turbines in series" is now universally used in all but very small engines.

We draw attention to the fact that Parsons recognizes only four useful types of turbine; first, his own compound reaction type, which represents 90 per cent of all marine turbines in the world and 50 per cent of the land turbines; second, the De Laval, which is used only for small powers; third, the multiple-impulse, compounded, or Curtis turbine, which is being chiefly used on land but has been fitted also in a few ships; and lastly, a combination of one or more multiple-impulse, or Curtis, elements with his own compound reaction type. He dismisses the other varieties as being simply modifications of the original types, which possess neither originality nor scientific interest.

Parsons pays tribute to Curtis in the statement that the multiple-impulse type is "the only substantial innovation in turbine practice since the compound reaction and the De Laval turbines came into use." First proposed by Pilbrow, in 1842, it was first brought into successful operation by Curtis in 1896. Curtis uses the De Laval divergent nozzle, but he also uses compounding by employing from five to nine separate stages, as compared with the fifty to one hundred stages of the reaction type. The Curtis type shows very little loss from leakage, and, in spite of their low intrinsic efficiency, one or more multiple-impulse wheels can, in certain cases, usefully replace the initial blading of a reaction turbine. At the high-pressure end of the Parsons turbine, where the blades are short, the leakage over the ends of the blades is large in proportion to the effective driving area of the blades themselves. Parsons, in most cases, prefers to use one multiple-impulse wheel for utilizing the energy of the high pressure steam and reducing its velocity to a point at which it is most efficient for use in the long characteristic rows of blading in his own turbine.

It is certainly interesting to note how these two leading types have come together, the ideal turbine being a combination of one or more Curtis impulse stages combined with a compound reaction turbine for developing the energy of the steam in the lower ranges of pressure.

Parsons was convinced that a high-speed turbine would give even better economy than the combination type, if its high speed could be accommodated to that of the propeller. He turned his attention to the De Laval helical gearing, and decided to apply it as the solution of the marine turbine problem. He took a typical cargo boat, the "Vespasian," of 4,350 tons displacement, overhauled her machinery, putting it in first-class condition, and ran a series of trials, in which the consumption of coal and water was carefully measured. Then, leaving the boilers, shafting and propellers in place, he took out the triple expansion engine and replaced it by a high and a low pressure turbine, which he geared in the ratio of 1 to 20 to the propeller shaft, the reduction being from 1,400 revolutions of the turbine to 70 revolutions of the propeller. The vessel was put through trials exactly similar to those made under her triple-expansion engines, and the geared turbine showed a gain in economy of 15 per cent. Subsequently the propeller was altered, and the gain was increased to 22 per cent. The new machinery is lighter than the old, and it has the great advantage that in heavy weather there is no troublesome racing of the propeller.

Engineering

A Three-mile Railway Tunnel into Montreal.—The Canadian Northern Company in deciding to build a tunnel into the city of Montreal have followed the example of the Pennsylvania Railroad in spending a vast sum of money to obtain convenient access to New York city. The plans include driving a tunnel approach to the heart of the city, building a large terminal passenger station there, erecting extensive freight yards and sheds, and electrifying the whole system. The cost of the scheme is set down at $25,000,000.

Gear for Opening and Closing Lock Gates.—The first of the machines for operating the miter gates in the Panama locks is now being erected. As some of the leaves of the gates are 60 feet wide by nearly 90 feet high, the operating machinery has to be extremely heavy. The opening and closing will be done by a massive arm weighing five tons, which is connected at one end to the gate and at the other to a crank pin on a geared wheel, which is 19 feet 2 inches in diameter, and weighs about 17 tons.

Growth of Steel Car Construction.—We have watched with much satisfaction the rapid growth of steel car construction in the United States. Out of a total number of over 54,600 passenger cars, 3,000 or over 5 per cent are built of steel. The forecast of this year's contracts shows that over 60 per cent of the new construction will be all-steel cars. It is a matter of surprise, not that the growth of the steel car is so rapid, but rather that the introduction has been so long delayed. It has the advantages of being stronger, unburnable, and possessing a life which, with proper care, should be prolonged indefinitely.

Forward Turret of "Maine" Found.—Considerable interest attaches to a recent dispatch from Havana stating that the forward turret of the "Maine" has been located. The size of the structure and the fact that it contained two ten-inch guns would preclude its being blown very far from the hull of the ship, even by an explosion of such power as was developed when the forward magazines blew up. The turret was found in the mud twenty feet to starboard of the ship's hull and thirty feet aft of its original position, where it lay upside down. This was to have been expected, for the deck on which it stood was itself inverted, being blown up and folded entirely back upon the vessel.

A Mill Run by Tidal Power.—The harnessing of the tides is a problem which we are apt to consider as belonging to the nineteenth and twentieth centuries, but residents along the New York and Connecticut shores of Long Island Sound are familiar with an interesting old mill, still in operation, which was erected at the close of the Revolution, and has been in more or less constant operation ever since. Originally power was developed through two under-shot wheels which, in course of time, were replaced by turbines. The waters are impounded at high tide in an artificial basin, and are released when the tide commences to fall. Although only seven feet of maximum rise and fall are available, nearly 40 horse-power is developed by the turbines.

Fatalities in Building Panama Railroad.—One of the most potent arguments against the construction of the canal at Panama, in the days when the building of this work by the United States was under discussion, was the frightful fatalities which were supposed to have attended the construction of the Panama Railroad in the middle of the nineteenth century. "A dead man for each cross tie" was a favorite theme with the magazine writer and the politician. General George W. Davis, U. S. A., first Governor of the Canal Zone, has exploded this time-honored story by showing that whereas the number of ties amounted to 140,000, the road never employed, during its five years of construction, more than 7,000 laborers. In its first four years of operation the railroad carried 196,000 passengers, not one of whom contracted illness as the result of crossing the isthmus.

A Difficult Engineering Problem.—German ingenuity, says the London *Evening News*, has solved a difficult engineering problem at a Doncaster colliery, where in sinking a shaft, water was encountered. It was being pumped out at the rate of 7,000 gallons a minute, and it looked as though the engineers would be beaten. Then the Germans came to the rescue with their freezing process. They bored holes around the shaft to a depth of 400 feet. These holes were then lined with steel tubes, and an inner tube was inserted, down which brine was pumped from the freezing plant, converting all the water, sand, and bad ground into a frozen mass. The sinking was then continued through the ice-wall. When the bottom of the ice had been reached iron tubing-plates were fixed and the water thus held back. After the work was completed, warm water was pumped down the tubes to thaw the ground gradually. The frost-wall was so strong that it has required three months to thaw.

Electricity

Electrification in St. Petersburg.—According to recent reports, it appears that the Russian government is to adopt electric traction on a number of sections of railroad, especially in the district around St. Petersburg. The conditions are favorable for carrying this out; for a good supply of water power for operating electric stations can be secured from the falls of the Volkhoff River in the Novgorod region. This stream alone can be counted on for upward of 50,000 horse-power.

Pederson's Rapid Telegraphy.—The new Pederson system of rapid telegraphy was tried between Esberg and Lyngby in Denmark not long ago and it appears to be a success according to the recent reports. The distance was about 160 miles in this case, and it was afterward worked between Lyngby and Knockroe in Ireland at a much longer distance, 870 miles, through submarine cable. About 300 words a minute is the speed that has been reached. The messages are printed on a paper strip.

Aluminium Bus Bars.—Aluminium is being used in some of the German electric stations instead of copper for the heavy bus bars of switchboards, and it is claimed that the economy is 40 per cent over copper. Care must be taken to have clean surfaces when joining the bars in order to secure a good electric contact. When aluminium and copper bars are joined together it is the usual practice to put tin foil between the bars so as to have a good joint, or else to tin the surfaces. It is also necessary to protect the joints against dampness and this is done by a coat of varnish.

Powerful Wireless Telegraph Station in Rome.—The Marconi company and the Italian government have made an agreement for erecting a large wireless telegraph station in the suburbs of Rome. It will have six high towers built of timber and iron on the Coltano plan. Two of the towers are 240 feet high and the remainder 150 feet. In connection with the towers there will be used an antenna of 1,200 feet total length and covering a surface of 16,000 square yards. The plant will have two Diesel oil engine electric groups of fifty horse-power each. It is expected to cover long distances with this plant.

A Subway for Rome.—The city of Rome is engaged on a project for an electric railroad running to the sea-coast at Ostia, together with a subway tunnel for the part which crosses town. For this latter the work is to be done in connection with the Paris Metropolitan Company. Work will begin as soon as the government grants the franchise. The subway starts from the center of town near the Forum and runs to the city limits at the St. Paul's gate. It will accommodate a double track tunnel. It is planned to finish the subway part of the line in three years and then begin on the Rome-Ostia line, which will take about two years to build.

Lighting Copenhagen from Trollhattan, Norway.—The great hydraulic plant of Trollhattan, Norway, is to increase its capacity by adding two new turbo-generators of 10,000 horse-power size, and when these are installed the station will have 60,000 horse-power in machines, as there are now erected four units of the above size. Later on, however, the station will have as much as 80,000 horse-power. A project is on foot for running a submarine cable so as to take current from the plant to the city of Copenhagen, and engineers find that there are no special difficulties in the way of carrying this out. An under-sea electric line is somewhat of a novelty, and so the results will be watched with interest.

A Subway in Venice.—Venice is to be connected with the island of the Lido by a subway tunnel which runs under the lagoons. The island is much frequented in summer and lies about two miles off. The city terminus of the electric line is to be located at St. Mark's Place in the heart of town, and the road will be at some distance below ground, about 25 feet, so that electric elevators are to be put in for this purpose. The tunnel will run in a straight line under the Giudecca and St. George islands and will end at the Lido at the point known as Four Fountains. It is expected that the trip will be made in about five minutes.

Boric Acid in Nickel Plating.—Small hollows or pit marks on the surface of electro-plated nickel can be avoided by the following method. It appears that such marks are caused by gas bubbles which collect on the surface of the object. A German inventor finds that it is a very good plan to add boric acid to the plating bath and this prevents the formation of hydrogen bubbles. The proper amount is three parts of boric acid per 100 by weight. However, as this does not dissolve well in the cold, it is recommended to take out part of the bath and heat it with the boric acid, then add the solution to the bath. In this way there is produced a clean nickel deposit, and as it is soft it can be easily polished.

Science

Preserving Fats.—Natural fats may be kept unaltered for a long time by the addition of 1 to 5 per cent of bismuth subnitrate.

Hats and Queues.—The experience which Hong Kong had recently in connection with the abolition of the queue has been repeated in various places. A sudden demand has been created for hats, and the Osaka factories are working day and night to fill orders. Tens of thousands of hats are suddenly called for. Outside of war material, this is probably the only article of commerce which has been benefited by the disturbances.

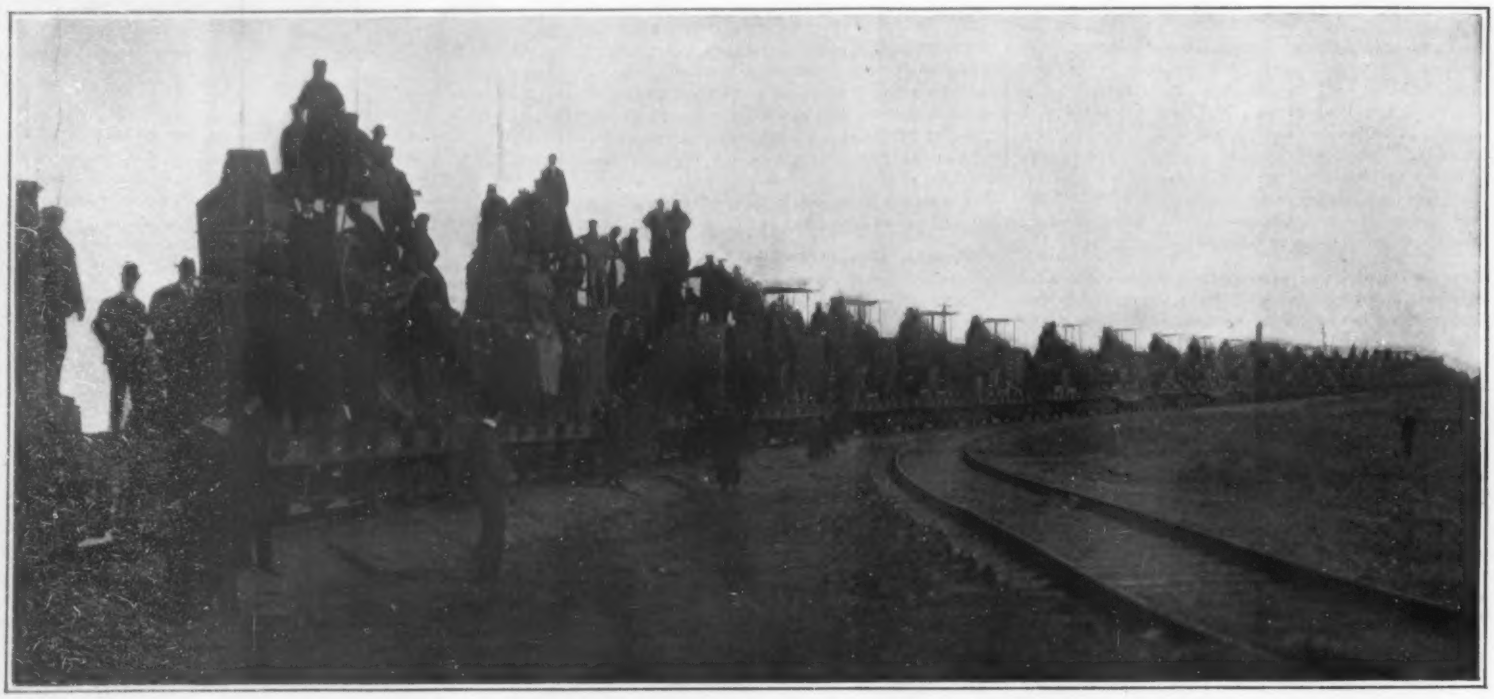
American Recognition of Pasteur.—A few thousand dollars donated by John D. Rockefeller will serve to preserve forever the little tanner's cottage at Dole, in France, in which Louis Pasteur was born. This tribute from a wealthy American, although gratifying to French scientists, seems also to have aroused much comment. Why, it is asked, are Frenchmen of wealth so indifferent to the achievements of their own scientific men that they allow foreigners to preserve the houses in which they were born?

Palladium Toning.—Silver chloride prints, printed somewhat deeper than the final shade required, are immersed for six minutes in a 3 per cent solution of common salt, rinsed, and toned in a bath consisting of 5 cubic centimeters of a 1 per cent solution of palladium-potassium chloride, sodium chloride 0.8 gramme, oxalic acid 1 gramme, and water 100 to 200 cubic centimeters. The stronger solutions give brown, black-brown and black tones, while the more dilute ones produce sepia shades. Fixation is effected by hyposulphite, as usual.

Abolishing the Drinking Cup.—Commenting upon the abolition of the common drinking cup in twenty-four States, the *Journal of the American Medical Association* remarks that so successful has been the campaign against the common drinking cup that the public has come to demand the paper substitute as a matter of right. The moral is: Saturate the public with facts, and after the public is convinced it will act. A similar campaign ought to be made in favor of the paper towel, which, we understand, is now introduced in the better hotels and offices.

A Primitive People.—A people without any form of religion, without superstition, devoid of any thought of the future state, has been found in the interior forests of Sumatra, according to Dr. Wilhelm Valez, the geologist of the University of Breslau, who has made extensive journeys through the island. There he found the Kubus, as he named them, who are scarcely to be distinguished from the small man-like ape of the Indo-Malayan countries. They are wanderers through the forest seeking food. They have no property. They are not hunters, but simply collectors. They seek merely sufficient nuts, fruits and other edible growths to keep them alive. The Kubus wage very little warfare upon the small amount of animal life in their silent and somber land. The only notion he could get from them of a difference between a live and a dead person was that the dead do not breathe. He infers that they are immeasurably inferior to the paleolithic man of Europe, who fashioned tools and hunted big game with his flint-tipped arrow and knife. Intellectual atrophy is the result of the Kubus' environment. The words they know are almost as few as the ideas they try to express.

Mysteries of Woolen Fabrics.—Woolen fabrics appear to undergo a change after they have been made up into clothing, and even fabrics of the best quality, and their appearance and texture become modified. This seems to be due to atmospheric effects, and the stuffs lose their good appearance, becoming streaked or swelled up in places. For the best qualities, experiments were made by stretching the fabrics upon frames up to 150 feet length in covered sheds so as to expose them to the air beforehand, but without avail. A new method is devised by Otto Huckenbech in Germany. He noticed that when the stuffs had been stretched on the frames while the weather was cold and damp the effect was better and the fabrics kept a good aspect. Then he used an artificial cooling chamber, but found that a better way was to treat the newly-made fabric when rolling out horizontally by sending up a blast of cooled and damp air from an air box placed underneath and provided with a long slit. Ice is put in the lower part of the box for the purpose. As this proved expensive, he made a new apparatus, and now the fabric passes through a long closed cooling chamber. The cold air sheet from a cooling box strikes the fabric at the bottom as before, but now the used air is collected from the main chamber and goes back in a closed path to the cooling box so as to be sent out again. A worm tube with a refrigerating brine occupies the bottom of the cooling box, and the air is moistened by a water spray within the box.



Embryo tractioneers at Regina, Saskatchewan, and a trainload of work for them.

Making the "Tractioneer"

The Successor of the Old-time Thresherman—Schools Where Traction Engineering and Farming are Taught —"Tractioneers" Who Earn from $100 to $200 a Month

By Lynn W. Ellis

PROBABLY no agricultural development of the last decade is of more interest or greater significance than the rapid advance in the use of the traction engine. The first real impetus to power farming did not come until after the opening of the twentieth century, and the coming of the gas tractor was the first step in making power farming universally possible. Since then, "steam plowing" has become "traction plowing," and as tractors began to be used for disking, seeding, harrowing, hauling binders, threshing and marketing, filling the silo, shredding and grinding corn, sawing wood, and a dozen other purposes, the term "traction plowing" was outgrown and "traction farming" took its place.

The old-time thresherman was little more than a stationary engineer. With the coming of the all-purpose tractor, his duties multiplied. Besides keeping his engine in trim, he had to learn to drive straight, avoid holes and obstructions, and above all to earn money for the owner of the outfit by keeping it eternally on the move. Out of the necessity has grown a new type—a farmer-engineer of high caliber, tersely termed a "tractioneer." No other trade just fits him for his work. Only that combination has succeeded which is made up of common sense, a little engineering skill, some farm experience and general all-round executive ability. It is small wonder that, with the manufacture of tractors increasing by leaps and bounds, the skilled tractioneer is at a premium. The tractioneer may be the farmer's own son, or the farmer himself. He may be a hired man, earning only slightly above the old wages, or he may be a Jack-of-all-trades, picking up his knowledge of the game at the owner's expense. However, in the sections where traction farming is practiced in dead earnest, the tractioneer's job is a responsible position, paying him from one to two hundred dollars per month and his rough living. He gets results, and upon the rapid increase in his kind depends much of the success of traction power on the farm.

The tractor clearing land ahead of the plow.

None of the old methods of instruction were equal to turning out exactly the man for the place. The pressure for training was first brought to bear on the factories, until it became necessary to restrict the number admitted for instruction. Then, in those States where traction farming had developed faster than courses of study in the agricultural colleges, short courses were instituted, and finally into the regular curricula courses were introduced, giving full instruction upon the theory and practice of tractioneering. Beginnings of the study of farm motors were made in nearly all colleges, even down in the corn belt where the tractor has not yet made its influence widely felt. At all of these public training schools,

Showing how a lesson is learned in grinding valves.

Students in farm-motoring learning something about transmissions.

MAKING THE "TRACTIONEER"

A class in farm-motoring moving a college building.

practical laboratory work was prominently featured, and manufacturers of engines were only too willing to supply the necessary material. Where requested, they gladly supplied experts to assist the professors in making all details clear.

These agencies combined were still unable to turn out tractioneers enough to meet all demands, especially since the coming of the internal combustion tractor in popular sizes. A large percentage of engines were sold to unskilled purchasers and in consequence with nearly every engine an expert had to be sent for starting it and giving the purchaser the necessary instruction. Keeping an expert four or five days with every engine sold proved an enormous expense to companies building from forty to sixty tractors a week. During the shipping season the pressure for experts became greater than factories could easily supply, and this was aggravated by the frequency with which the expert sent with a machine was induced by the owner to stay at considerable advance in salary. For their own protection, therefore, tractor-building companies were forced to organize schools so that purchasers might be given instruction during the winter.

Licenses are often required of steam tractioneers, but of gas engine operators scarcely ever. Attendance at steam engine schools is partially accounted for by legal requirements, but gas tractor students reflect a growing determination to get results by being properly prepared. The public has accepted the general reliability of both steam and gas tractors and demands proper operation of them. It is no longer the custom to say that an engine will not run. The modern view, in case of failure, is that the operator cannot run it.

University Short Courses.

Those States where the tractor has long been of great economic importance naturally have the most comprehensive courses of instruction. At the University of Minnesota four weeks, morning and afternoon, are given to a thorough review of either steam or gas tractors, as the pupil may elect. The steam engine course includes a study of steam and its phenomena; the types, construction and repair of boilers and boiler fittings; fuels and principles of combustion; the engine and traction mechanism in all details; testing the tractor and its field operation. The gas engine student studies the mechanism, fuels, carburetion and combustion, ignition, cooling, lubrication and the practical handling of the tractor. This course is one of the most complete, and further includes exercises in the blacksmithing, babbitting, belt-lacing, pipe-fitting, rope-splicing, soldering and tube-setting apt to be required of the tractioneer. Instruction continues for four weeks during the latter part of May, and the early part of June. Classes are held every day in the week, but Saturday is devoted to visiting various tractor factories. Minneapolis is the hot-bed of the gas tractor industry, and the numerous factories and branch houses located in the Twin Cities furnish an abundance of sample tractors for laboratory purposes.

During the past year an entrance requirement of one year's experience with plowing or threshing engines was made and a registration fee of $15 required. Men with only one year of experience who successfully completed the course were eligible to a second class engineer's license, permitting them to operate boilers and steam machinery not exceeding 100 horse-power in size.

At the South Dakota Agricultural College, near Fargo, both gas and steam engineering courses are given during the winter in connection with other work of the short agricultural course. In addition to this, a summer course, which draws a larger percentage of experienced men, is held during June. The courses are

A big plowing outfit, resolved into unit sections, on its way home.

The wake of a traction plow.

A crowd of Kansas short course men listening to a manufacturer's lecture.

MAKING THE "TRACTIONEER"

made as beneficial as possible to the man in the field, and during the summer school only such things are embodied as can be easily grasped. The student is given the opportunity to handle many different engines under working conditions. He practices guiding the engine on the road, and lining it up with the threshing separator. He must watch the fire, the pump, the injector and the lubricating system.

The general care of the engine is constantly hammered in by instructors with whom the whole object is to make a man conscious of the responsibility he must assume. Instruction in gas tractioneering is carried out along the same lines, i. e., lectures in the forenoon and actual work in the afternoon. After dinner, each student is given a laboratory exercise to drive home the information given in the lecture room. For instance, the jump spark is studied in detail on one engine, mixtures on another, auto-sparkers on a third, and so on. No experience or entrance examinations are required.

At the University of Nebraska, a few lectures only are given to the short course students in the winter. Ninety to one hundred students in the three-year short courses have instruction on traction engines, and in the long courses from six to ten students each year take up the work on farm motors, which includes both practical and theoretical instruction regarding tractors. Much the same situation exists at Iowa State College, where the instruction on tractors is included under the general heading of Farm Machinery and Farm Motors. In both these corn-belt institutions, however, classes in these subjects are growing year by year.

It is significant of the tractor's importance that within two years after the establishment of the Manitoba Agricultural College, instruction in traction engineering was begun. A set of new buildings for the University of Saskatchewan at Saskatoon will be utilized for this purpose, even earlier in their history. One of the large tractor companies has secured their use this spring, giving a free course of instruction to all applicants in co-operation with the university corps of teachers. At the Kansas State Agricultural College similar work is given, and even greater stress than elsewhere is laid upon having commercial lecturers discuss the principles of each tractor represented in the laboratory.

Manufacturers' Schools.

While the instruction given by the tractor companies is much less disinterested than the public courses, they are still productive of great benefit. One manager who conducted such a school in 1911 insists that his expense for experts was cut at least in half by the pride his pupils took in their diplomas. Not one of his "graduates" likes to admit that he is unequal to an emergency covered by his sheepskin.

One concern building a four-cylinder tractor aims to give the theory of gas engines in as brief and simple a manner as possible, spending three-fourths of the time in drilling in a thorough knowledge of the particular engine made by the company. Lectures are given each morning by the instructor, supplemented from time to time by others from prominent engineers from the outside. No text books are used, but every precaution, including frequent reviews, is taken to impress important details of construction upon the student's memory. The afternoons are devoted to the working of engines under load both in traction and under belt, not more than five men being allotted to each engine.

As this frequently takes place out of doors, in zero weather, the troubles incident to the running of the gas tractor under most adverse conditions are experienced. Three nights a week the foremen on the erecting floor remain, each taking five or six students in hand for the evening's work. Thus the students are given work in the actual construction of engines, practice which is of inestimable value in making repairs in the field. On Saturday, the students are taken into the testing-room, where all details of motor operation are gone into thoroughly. Since the beginning of this company's school work two years ago, over five hundred students have received diplomas, indicating their ability to handle this particular type of tractor.

One company giving an apprentice course places these green hands under the eye of one of its oldest experts. The men are paid a sum sufficient to cover their board, room and other living expenses. Their instruction consists mainly in the actual work of building tractors. They must build the frame and motor, and assemble the entire tractor. They are shown how to use machine tools and finish parts ready for assembling. They follow the tractors to the test floor, make the brake horse-power and reliability tests, and then complete the final inspection of the engines as they come from the test shed. They make the dynamometer tests necessary to establish the rating of each tractor before it leaves the factory. They are given field practice which includes the location of all of the troubles the traction engine is heir to. They are instructed in the care and timing of magnetos and in the electrical wiring which goes into the ignition system. They test different lubricating oils and study thermostatics as applied to the cooling system.

These men naturally become highly skilled experts, provided they take kindly to this sort of instruction. They are given the actual work of the factory, yet are not allowed to interfere with the work of the other departments. The cheapness of their labor balances the extra cost of inspection and instruction. The company is making good men for its future needs and at the same time utilizing their services in production. In this way not even the time of the student is wasted, just as in the test house much of the testing of engines is done on electric generators, which in turn develop power to build more engines.

At a typical branch house school of this same company, lectures and demonstrations are given in the morning and trouble hunts fill the afternoon sessions. In the evening the students may carry on any experimental work they may see fit. This year, the school has been thrown open to every one interested in internal combustion tractor engines, four types and seven sizes of which are made and sold by this company. Tractors partially dismantled and mounted for demonstration purposes are included in the laboratory equipment and a dozen or more tractors are available for the practice work.

The first week is largely given over to learning the engine from the theoretical standpoint, including the principles of combustion, ignition, lubrication, cooling, valve setting and the care of the bearings. The final test of the student's ability in each case is the starting of the engine. On several occasions, squads are given fifteen or twenty minutes to put an engine as far out of commission as possible without damaging any part. All squads then shift, and a prize is given the squad first putting its engine in running order. Some squads finish in an hour and some keep at work far into the night, rather than face the ridicule of the more successful.

As a final day's drill the field problems involved in traction farming are brought up, including the economical planning of work, the proper plowing conditions for best crop results, the proper hitching of binders, harrows, drills and disks in connection with engines, the proper relation between engine and separator, and the general all-around handling of the tractor as a farm engine.

Instruction by Correspondence.

Still another company has a correspondence school, in which the general plan of the leading correspondence schools of the country has been followed. Each lesson is put up in neat pamphlet form. Three lessons are sent out on the start so that the second may be studied while the answers to questions on the first lesson are in the hands of the reviewers at the factory. Lesson Four is sent back with the criticism on the first examination, hence the pupil always has two lessons to study ahead.

The lessons are very comprehensive and cover every phase of "Traction Farming" and "Traction Engineering," distinction being made between the use of engines in the field and the expert knowledge required to care for and repair them. The lessons go fully into the theoretical discussion of the engine design, fuels and the process of combustion, as well as the mechanical details of the particular types of tractors built by this company. Under the head of "Traction Farming," is given practical instruction in methods worked out on the company's near-by experimental farms. This course was announced at the psychological moment, when the summer's accumulation of reading matter had been pretty well devoured and the average farmer faced a long stretch of idle winter evenings. Tuition is free and the lessons are written in plain, understandable style that appeals to the wide audience that has been attracted. Over 1,100 men are now enrolled, and the examination papers show every evidence of great enthusiasm.

Not the least popular method of instruction has been that of the correspondence schools conducted by two trade papers, one in the United States and one in Canada. Lesson sheets are finally exchanged for bound volumes, and constant stimulus to study comes from the editorial columns. These schools have more than paid expenses, to say nothing of their value in building up subscription lists.

The agricultural, trade and technical papers have devoted a great deal of space during the last few years to educational matter on the subject of both stationary engines and tractors for the farm. These schools represent attempts to reduce to a more exact science a more or less spontaneous outgrowth of conditions. Little by little the essentials are being discovered and taught, and some really valuable literature is being developed. Naturally the manufacturers are most interested in educational work as a means of advertising. The public institutions, however, are finding a pressing demand for information along these lines. It comes from men who want to operate their own tractors on a more efficient basis, but even more so from men who wish to become proficient in order to pick up the fancy salaries paid to experts during the working months. Eventually, perhaps, every farmer will learn the art of running a tractor from his neighbor, and organized education along these lines may again revert to the more thorough and technical training of the few. This year, however, for every six tractors sold, one man will fit himself for more efficient service at a school planned for the average man, and the idea of educating the mass is spreading, not only in advertising, but in colleges.

Our Good Roads Number

THIS issue will bear date March 16th. Of all the elements which contribute to modern commercial and industrial progress, efficient means of transportation is perhaps the most important. Realizing this, Mr. Coleman Dupont, of Wilmington, Del., is building at his own expense a wonderful highway 200 feet in width and 110 miles long, right through the State of Delaware. The road is an object lesson for the whole country; it will develop the State of Delaware by showing the farmers how greatly they are handicapped by want of good roads. Every twenty miles there will be an agricultural experiment station, and landing and starting places will be provided for aeroplanes. To insure that the road would be built according to the very latest and best practice, European and American engineers were called in for consultation. Mr. Dupont will write an article for the March magazine number, in which he will give an illustrated description of this great undertaking.

The Department of Agriculture, through its Office of Public Roads, is doing splendid work in the good roads movement. Mr. Logan Waller Page, director of the office, will write for the good roads number an article, in which he will describe some of the most interesting work that has been done in his laboratory in testing of road materials, etc. He will describe the different methods of road building, and point out what kind of road is best suited to any particular local conditions. The article will give in compact form the very kind of practical information which the farmers of this country are asking for on this important subject.

Transatlantic Wireless Telegraphy Without Antennas

HUGE towers for carrying up the antenna system to sufficient height above ground have been built at several places, e. g., Poldhu, Clifden, Glace Bay, to make transatlantic radio-telegraphy possible. The highest building in the world, the Eiffel Tower (about 1,000 feet in height), has in its turn been utilized for the purposes of wireless telegraphy, while the sender tower of the Nauen radio-telegraphic station was recently raised from 330 to 660 meters height, thus allowing the African colonies to be reached from Berlin by wireless telegraphy.

It will therefore be readily understood that experiments recently made in Berlin with a new arrangement due to Prof. Zehnder should arouse more than usual attention. The new scheme in fact does away with any antenna, an ordinary insulated conductor wire carried on telegraph poles being connected at both ends to the ground, with or without the intermediary of Leyden jars. The total length of wire between the two ground connections should at most equal one-half wave length of the alternate current employed. If, for instance, the wave length in air be 4,500 meters, which is about sufficient for transatlantic operation, the ground connection would have to be located at about 900 meters distance in the ground and only 250 meters in water. This conductor is excited as usual in its central part by a Braun vibratory circuit, the length of which is tuned to the frequency of the vibratory circuit.

This new scheme at the same time constitutes a system of directed wireless telegraphy, the direction of the wire itself being the most favorable for sending. In a like manner, if a receiver be substituted for the exciter, the preferential receiving direction will be given by the wire.

This scheme, in spite of the provisional character of the arrangement, allowed telegrams to be sent with small-size sending apparatus and without antennas to many hundreds of miles. When using the ordinary type of receiver, messages could be received over several thousand miles, e. g., from Canada across the Atlantic Ocean, as far as the surroundings of Berlin.

An additional advantage of the scheme suggested by Zehnder is the possibility of installing the whole of the apparatus in the interior of a building, fortress, man-of-war, etc., thus protecting it against destruction by storms, gales or the enemy's guns.

Incidentally, these experiments go to show that the transmission of electric waves in great part occurs through the earth itself.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Lieut. Rambaldo

To the Editor of the SCIENTIFIC AMERICAN:

I regret to learn from your paper that Lieut. Rambaldo, who perished this year in consequence of a balloon accident in the Dutch Indies (Isle of Java), was a "German."

As Mr. Rambaldo was one of the most prominent and promising junior officers of the Dutch (home or colonial) army, being thoroughly "Dutch" as well by birth as by behavior a "Hollander" of the true old kind, persevering nearly beyond possibilities one of the Stuyvesant race, not unknown to your countrymen. I herewith beg to request you to redress the above-named error. W. VAN REDE.

Rotterdam, Holland.

The Storage Battery Cars in New York

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 30th, 1911, in the article entitled "Retrospect of the Year 1911," you state that street cars using the Edison storage battery have been giving satisfactory service on the streets of New York city.

We wish to advise you that but one Edison storage battery car was used in New York, and that this was put in service for experimental use, and it is no longer in service.

There are 51 cars now in operation in New York city using batteries of this company's manufacture.

We trust that you will make proper mention of the above in your columns.

THE ELECTRIC STORAGE BATTERY COMPANY,
Philadelphia, Pa. CARL H. REED.

Naval Philosophy

To the Editor of the SCIENTIFIC AMERICAN:

In the event of sudden war would not our navy be better off with a slightly smaller number of battleships, accompanied by the proper number of scouts, destroyers, colliers, repair ships, and other necessary auxiliaries, than with a larger number of battleships without these important auxiliaries?

If this is true, why not stop building battleships for a year or two, until the navy is properly proportioned, and then resume their construction accompanied by auxiliaries in their proper proportion?

Salem, Mass. JOHN PICKERING.

[There is food for thought in the above suggestion. There is a certain element of strength in the fact that a navy is well balanced in its make-up; but we think that in view of the rapid additions of battleships and battle-cruisers now being made by other powers, prudence demands that we make no elimination in our battleship programme. We should pull up our auxiliary strength by special emergency appropriations. —EDITOR.]

Nitrogen and the Soil

To the Editor of the SCIENTIFIC AMERICAN:

I wish to state through the SCIENTIFIC AMERICAN that I published a piece of research work on the above subject in the *Journal of the American Chemical Society*, August, 1898, in which it was shown that the pea plant may elaborate more nitrogen from the air than it uses in its growth, and that this excess of nitrogen diffuses into the soil where its presence is revealed by analysis, and that other plants growing with the peas will make use of this nitrogen in their growth. I know of no prior researches either in America or Europe showing these facts. J. L. BEESON, Ph.D.

Georgia Normal and Industrial College.

[In the issue of December 9th, 1911, of the SCIENTIFIC AMERICAN, and some earlier issues, there appeared several letters on the subject of the absorption of nitrogen from the air into the soil through the agency of certain plants. We have received the foregoing on this subject, which it appears, in justice to the correspondent, should be given space. The discussion has, however, extended over a considerable period of time, and the Editor feels that the incident must be considered closed.—ED.]

How to Revive Our Merchant Marine

To the Editor of the SCIENTIFIC AMERICAN:

Since reading your editorial, "Why Not Revive Preferential Duties?" in your issue of April 1st, 1911, I have carefully considered everything appearing in the columns of your excellent journal relating to the revival and upbuilding of the American merchant marine.

Prior to that date I had been convinced from study of the subject that it would be almost impossible under existing conditions to restore our ocean shipping plying in the foreign and deep-sea commerce, to that prestige which it once enjoyed without the aid of liberal *government subsidies in one form or another*. My subsequent reading and reflection have corroborated that conviction.

Preferential duties may have been all well enough a century ago, when other governments probably discriminated in favor of their own merchant shipping, but owing to the changes wrought by time and by various treaties with foreign countries, their revival at the present day, so far from being productive of beneficial results, would in my judgment work positive injury to our shipping interests, as they would invite retaliation, which would produce vexation and irritation in our commercial relations with other countries.

With regard to the much-discussed subject of free ships, the writer must reserve his judgment until he can ascertain the facts in the case.

American shipyards and shipbuilders should be amply protected as well as shipowners; but it is contended that our shipyards are already taxed to their full capacity in the construction of domestic shipping, and hence, it is argued, would suffer no detriment from the admission to American registry of foreign-built ships. If this condition exists, so urgent is the necessity for the immediate construction of the vessels, it would seem that we should have free ships at least until American yards can enlarge their capacity for building all the ships we need.

Canton, Miss. JAMES G. MCBRIDE.

Difficulties in Steering Aeroplanes

To the Editor of the SCIENTIFIC AMERICAN:

In glancing over the daily papers, it is not an uncommon thing once in a while to learn of accidents, some of them fatal, which attend aviators here and abroad, a large percentage of which the reporters attribute to a "loss of control" in the air—an expression which leaves in doubt the real cause of the aviator's loss of control. Being a practical aviator, I venture through the columns of your esteemed paper to bring up the question before the reading public for mutual discussion and exchange of opinions. Meanwhile, permit me to throw some light, from a scientific standpoint, on "the difference between a right-hand, and a left-hand, turn in an aeroplane, and the danger involved therein."

In running the aeroplane on the ground, it can be easily noticed that the machine tends to turn to the opposite direction of the revolving propeller; and if no steering is applied to counteract that tendency, the aeroplane turns round and round in small circles until the power is shut off. This is due to the gyroscopic force created by the reaction of the revolving propeller. The aeroplane then possesses the same tendency while traveling through the air, which tendency if not counteracted by means of steering by the rudder, gives the aeroplane a declinatory motion causing it to dive to the ground. Therefore, to keep the aeroplane straight in flight, the rudder is, most of the time, set slightly to the same direction as the revolving propeller, that is, in the opposite direction of the gyroscopic force.

From the foregoing, it is understood then that there must be some difference in turning right or left with an aeroplane. For the sake of illustration, let us consider a monoplane in which the propeller, from the view point of the pilot, usually revolves from left to right. Owing to the effect of the gyroscopic force, the monoplane always tends to turn left, and, therefore, the left turn is effected with a little steering by the rudder. That is to say, that the left turn is caused by the effect of the rudder plus that of the gyroscopic force. At the same time the machine points a little downward, and as it points downward its speed of flight increases with the decreased resistance. With the increased velocity a sharp turn then can be made. But in making a right turn which is in opposition to the gyroscopic force, more steering by the rudder is needed than in a left turn. That is to say that the right turn is effected by the action of the rudder minus that of the gyroscopic force. In this instance, the machine points a little upward. And as it points upward, its speed of flight decreases with the increased resistance. With the decreased velocity, the right turn is made almost twice as wide as the left turn; and in some cases the velocity decreases to such an extent that the supporting power may be lost and the machine sinks to the ground.

In a rotary-motored monoplane, the reaction of the rotary motor adds more gyroscopic force to that of the propeller, giving a greater effect on either turn. Therefore, when the machine points downward in turning left, it should be pulled up a little by operating the elevator to prevent the inclination which accompanies the gyroscopic force and causes the aeroplane to plunge to the ground. However, this is usually done instinctively by aviators in order to keep the machine on an even keel. But when the machine points upward in turning right, care should be taken not to lower the head too much by operating the elevator in order to bring the machine to an even keel, because the gyroscopic force might overcome the action of the rudder, in which case the pilot is apt to lose control and the machine plunges down to the ground.

In conclusion, let me add that the above explanation does not apply to an aeroplane with two propellers revolving in opposite directions, unless it is equipped with a rotary motor which might show only half the effect of what it would were it equipped with one propeller.

S. S. JERWAN, Aviator.
(Licensed by the Aero Club of America.)

New York city.

The Eight-hour Law and the Navy

To the Editor of the SCIENTIFIC AMERICAN:

I have been a subscriber to your magazine for several years, and consider the reading of it as one of the main necessaries of life, in the broad sense of the latter. And because of the respect and admiration which I entertain toward your publication, it pains me the more to find in its pages statements partial and prejudicial to a section of society large in numbers but having few defenders.

In speaking of the eight-hour law in your article on "Navy Yard Politics" and its effect on the shipbuilding industry, you do not for a moment admit the advisability of reducing the shipbuilder's margin of profit, finding the alternative in an increased cost of ships for our navy or in reducing the laborer's wage. And here is how you proceed in a not at all scientific wise: "In all of the shops where tools are worked, the decrease in production due to the shorter hours will be directly in the proportion to the time, or a decrease of twenty-five per cent, while the wages of the men will unquestionably be increased, so that their yearly income will be unchanged—a further burden on the cost of production of twenty-five per cent." This is as much as to say that the enhanced cost of production due to the establishment of the eight-hour schedule is equal to fifty per cent. Now, for a little plain arithmetic: if it takes 200 men in 300 working days of 10 hours each to build a ship for the navy, or 600,000 man-hours at a labor cost of $120,000 (20 cents per hour), it will require 250 men to deliver the same number of man-hours of productivity on an eight-hour schedule; and if the laborer's pay is increased to 25 cents per hour, the total labor cost will be $150,000.

In other words, the labor cost of the ship is 600,000 man-hours, which should be absolute value, the comparative value changing as the rate of labor's compensation changes. All this shows that there are no "further" burdens on the cost of production, but just one of twenty-five per cent, as you at one point suggest.

In regard to higher wages and correspondingly higher efficiency of production, a point which you fail to see, permit me to quote from the Tariff Board's report on the wool schedule of the "best ever" Payne-Aldrich tariff. Speaking of "Wages and efficiency," it says:

"The productive efficiency per one-man-hour for machine operatives and machines in the scouring, carding, combing, drawing, and spinning departments with 168 separate labor costs per pound, show wide differences in efficiency and cost, but indicate in general that the lowest labor costs per pound were in mills paying the highest wages."

There is another feature of the shipbuilding industry, and that is foreign competition, which serves many people as an excuse for demanding subsidies from the government (much as they hate paternalism in government). In regard to this foreign competition, permit me to quote from Henry Clay's speech in Congress on March 30th, 1824. In arguing for a temporary protective tariff he said this (according to the *New York Times*):

"In considering the fitness of a nation for the establishment of manufactures, we must no longer limit our views to the state of its population and the price of wages. All circumstances must be regarded, of which that is, perhaps, the least important. Capital, ingenuity in the construction and adroitness in the use of machinery, and the possession of the raw materials, are those which deserve the greatest consideration. All these circumstances (except capital, of which there is no deficiency) exist in our country in an eminent degree, and more than counterbalance the disadvantage, if it really existed, of the lower wages of labor in Great Britain. The pamphlet to which we have had occasion so often to refer, in enumerating the causes which have brought in England their manufactures to such a state of perfection, and which now enable them, in the opinion of the writer, to defy all competition, does not specify, as one of them, low wages."

From the mouth of a protectionist, it sounds like a plea to encourage at home backwardness and inefficiency in production, admitting the unimportance of the wage circumstance.

I hope you will pardon my disagreeing with you, and may you find consolation in Shakespeare's "no might nor greatness in mortality can censure escape."

Brooklyn, N. Y. S. STRIEZHEFF.

How the Scientific Farmer Fertilizes His Soil

Laboratory Methods Applied to Agriculture

By W. H. Beal

Office of Experiment Stations, United States Department of Agriculture

THE modern use of fertilizers is based mainly upon laws laid down by Liebig about seventy years ago as follows:

(1). "A soil can be termed fertile only when it contains *all the materials requisite for the nutrition of plants*, in the required quantity, and *in the proper form*."

(2). "With every crop, a portion of these ingredients is removed. A part of this portion is again added from the inexhaustible store of the atmosphere; another part, however, *is lost forever if not replaced by man*."

(3). "The fertility of the soil remains unchanged, if all the ingredients of a crop are given back to the land. Such a restitution is effected by *manure*."

(4). "The manure produced in the course of husbandry is *not* sufficient to maintain permanently the fertility of a farm; it lacks the constituents which are annually exported in the shape of grain, hay, milk, and live stock."

These laws are deduced from the fact that, although plants derive the bulk of their food from the air in the form of carbon dioxide and water, a small but essential portion, viz. the inorganic, or ash, constituents and most of the nitrogen, are drawn from the soil. In the application of the laws to the fertilizing of the soil it has been held that of the fourteen or more elements which plants require for their growth only a few, viz., nitrogen, phosphoric acid, and potash, and sometimes lime, are likely to be deficient in ordinary soils and must be supplied in the form of fertilizers. It is for this reason that the commercial value of fertilizers is based entirely upon the amounts of nitrogen, phosphoric acid, and potash they contain.

As Liebig points out, the balance of fertility is against the farm in ordinary systems of farming, but the fertility of the soil can be maintained practically unchanged, and even a balance in favor of the farm secured, if care is taken to restore to the soil the fertilizing constituents removed in farm products, as for example by feeding the crops to stock on the farm, carefully saving the manure and returning it to the soil, and, when practicable, combining rotation of crops and green manuring with leguminous plants (clover, peas, beans, and the like), which gain nitrogen from the air, with a system of stock feeding in which farm products comparatively poor in fertilizing constituents are exchanged for feeding stuff rich in such constituents.

The accompanying table shows the amounts of fertilizing constituents in one ton (2,000 pounds) of different farm products and indicates directions in which exchanges may be made with gain of fertility.

This table shows, for example, that the farmer who raises and sells 2,000 pounds of corn and purchases in its stead 2,000 pounds of wheat bran to feed his stock, gains thereby 21 pounds of nitrogen, 46 pounds of phosphoric acid, and 24 pounds of potash. If he sells 2,000 pounds of potatoes and buys instead 2,000 pounds of cotton-seed meal, the gain would be still more striking, viz., 135 pounds of nitrogen, 58 pounds of phosphoric acid, and 25 pounds of potash. The profitableness of such exchanges depends upon the prevailing prices, in any given case, for the products involved and upon the prices at which equivalent amounts of the fertilizing constituents can be obtained in the form of commercial fertilizers. It is important,

Fertilizing Constituents Contained in One Ton of Various Products.

Farm product.	Manurial constituents, Nitrogen.	Phosphoric acid.	Potash.
	Pounds.	Pounds.	Pounds.
Timothy hay	19.2	7.2	25.2
Clover hay	39.4	8.0	35.0
Alfalfa hay	53.2	10.8	49.2
Cowpea hay	49.6	13.2	47.2
Corn fodder, field cured	17.2	7.2	21.4
Corn silage	8.4	2.4	6.6
Wheat straw	8.6	2.6	14.6
Rye straw	10.0	5.8	15.8
Oat straw	13.0	4.4	24.4
Wheat	34.6	19.2	7.0
Rye	32.4	16.2	10.4
Oats	36.2	15.4	11.4
Corn	29.6	12.2	7.2
Barley	39.6	15.4	9.0
Wheat bran	51.2	58.4	31.4
Linseed meal	108.6	37.6	26.2
Cotton-seed meal	142.8	61.8	36.4
Potatoes	7.0	3.2	11.4
Milk	10.2	3.4	3.0
Cheese	90.6	23.0	5.0
Live cattle	53.2	37.2	3.4

however, for the farmer to keep such facts in mind and use them as far as practicable in an effort to keep the balance of fertility in favor of his farm.

It is obvious that there are many cases in which such a system as that outlined above cannot be followed, and the main, if not exclusive, reliance for maintaining and increasing the productiveness of the soil will have to be placed upon the use of commercial fertilizers. In any case, however, green manures and all of the available supply of barnyard manure should be utilized to the fullest possible extent, and only such commercial fertilizers bought as are needed to supplement the farm manures. Those countries, as, for example, England and Germany, which have practised such a system of conservation of fertility have maintained, and even raised, the level of production, while others, like the United States, which have been large exporters of fertilizing materials and feeding stuffs rich in fertilizing constituents and wasteful of farm manures, have experienced a decline in productiveness, which has led in many cases to excessive use of commercial fertilizers. There is no doubt that the quantity of fertilizers now used in the United States, especially in the older portions of the country, might be profitably reduced, or the returns from their use enormously increased, if more attention were paid to rotation of crops, deep and thorough tillage, green manuring with leguminous crops, the use of winter cover crops, and the like; in a word, by better methods of farming. A recent study of the farm practice in the use of fertilizers in the South Atlantic States made by J. C. Beavers of the Bureau of Plant Industry of the United States Department of Agriculture showed that with substantially the same total outlay for fertilizers the better class of farmers in that region obtained 1 to 2 bales of cotton, 40 to 75 bushels of corn, and 40 to 75 bushels of oats on soil where the poorer class of farmers get only ½ to 1 bale of cotton, 15 to 40 bushels of corn, and 15 to 40 bushels of oats. The difference is due to the fact that the more successful farmers have a better understanding of the use of fertilizers and employ better farm methods. It is simply the successful practical application of scientific principles, and inculcates the old lesson, which, however, many farmers have been slow to learn and put in practice, that fertilizers will not make up for poor farming and are worse than useless if not intelligently employed.

The use of fertilizers is most likely to prove profitable on soils in good physical condition, well tilled and abundantly supplied with humus. They can be used most freely, with surer prospect of profitable return, on high-value crops, such as are grown in market gardening and other forms of intensive farming. In any case, as Prof. E. B. Voorhees, of the New Jersey experiment station, urges, fertilizers should be used systematically in connection with systems of cropping and manuring which are carefully planned to meet the conditions of soil, crop, and season, and which enable the farmer to utilize to the best advantage home and local supplies of manure.

"In every State, or even locality," says Prof. Voorhees, "some one system of cropping is better adapted to the conditions than another. It may be the 'extensive system,' which includes large areas and such crops as grain, cotton, tobacco, or sugar cane; or the 'intensive system,' with smaller areas and crops of quicker growth and higher value. For the former, a method of manuring should be adopted which is not too expensive, but which provides for increased crops and gradual gain in fertility. It would be impracticable in extensive farming, for example, to attempt to increase the yield of a wheat crop from 12 to 30 bushels per acre by the addition of fertilizers only; for, as already pointed out, plant food is but one of the conditions of fertility, and if it were practicable from the standpoint of yield, it would be folly from the standpoint of profit."

In market gardening and similar intensive forms of farming, as already explained, larger amounts of the more expensive forms of fertilizers may be used with profit.

Dr. C. G. Hopkins, of the Illinois experiment station, declares that the fertility of a large proportion of the normal soil of America may be permanently

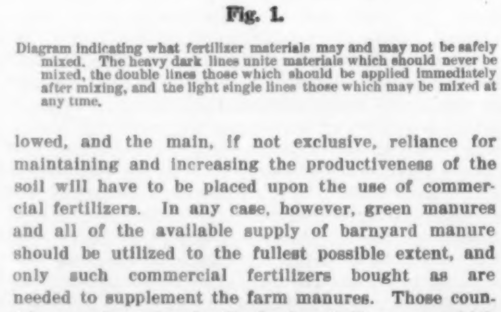


Fig. 1.

Diagram indicating what fertilizer materials may and may not be safely mixed. The heavy dark lines unite materials which should never be mixed, the double lines those which should be applied immediately after mixing, and the light single lines those which may be mixed at any time.

and profitably maintained by applying finely ground rock phosphate in connection with farm manures and green manuring with leguminous crops, and regular applications of finely ground natural limestone when soils become acid or sour. This system is designed especially to build up the fertility of the soil gradually but permanently. If the farmer desires to obtain

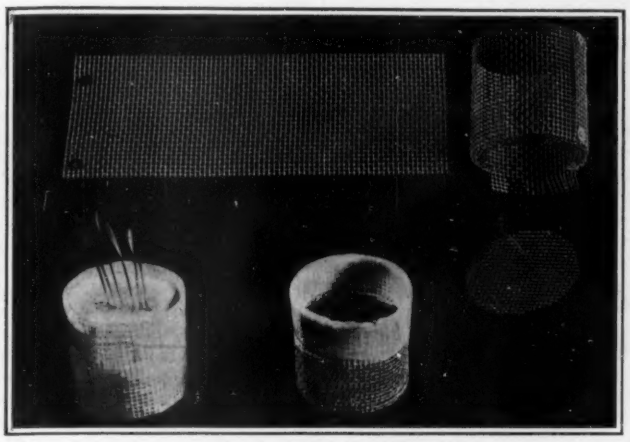


Fig. 2.—How the paraffined wire baskets are constructed in which the fertilizer requirements of soils are tested.

Fig. 3.—Dipping the wire basket in hot paraffin to secure an impervious coating.

the largest possible immediate return, more soluble and quick-acting fertilizers must be used.

In any case, however, as A. D. Hall, of Rothamsted, points out, there is a limit to the level to which the productiveness of the soil and the use of fertilizers may be profitably increased, for since the higher the level of production the larger the waste of soil fertility, especially nitrogen, and the greater the need of fertilizers, it is obvious that a point will ultimately be reached where the cost of the fertilizers will exceed the profits of the increased production.

In order to use fertilizers intelligently it is necessary to know the principal commercial sources of nitrogen, phosphoric acid, and potash. Nitrogen, which is the most costly constituent of fertilizers and the one most subject to loss, is derived mainly from nitrate of soda, which is the most available and, at present prices, one of the cheapest sources of nitrogen now in the market; sulphate of ammonia, also a readily available form of nitrogen, which is obtained as a by-product of gas works and coke ovens, and various organic substances, mainly slaughter-house and factory by-products, such as dried blood, tankage, dried fish, and cotton-seed meal.

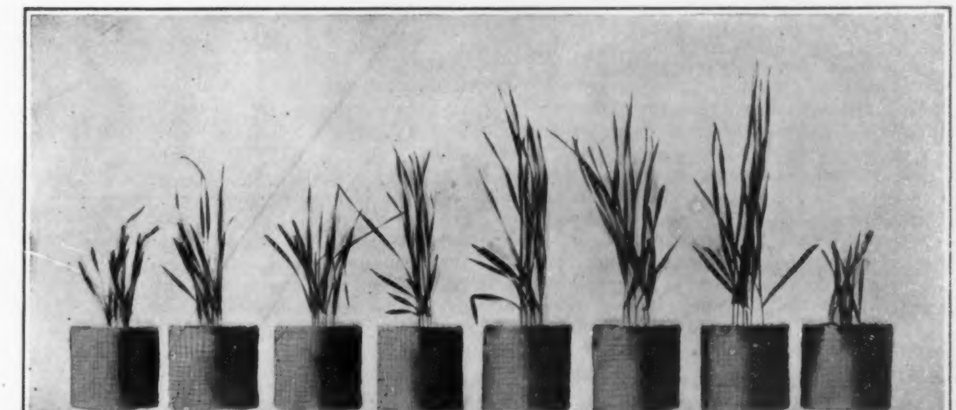
Phosphoric acid is derived mainly from bone, mineral phosphate, superphosphates (made by treating mineral phosphates with sulphuric acid) and phosphatic slag. The principal sources of potash are the potash salts—kainit, and muriate and sulphate of potash—obtained from the German potash mines.

These are the standard raw materials from which fertilizers are prepared. The raw materials may be purchased unmixed and applied separately or mixed as desired on the farm. The State experiment stations can furnish specific advice as to methods of mixing and formulæ for special crops and soils.

It is well to bear in mind, however, that the indiscriminate mixing of fertilizing materials is not a safe practice, due mainly to two facts: (1) The mixing may result in the loss of nitrogen, as when lime is mixed with guano or other organic matter, or may make a fertilizer less soluble and available, as in case of superphosphate to which lime has been added, and (2) certain mixtures, as for example potash salts and Thomas slag, "cake" and are hard to distribute evenly on the soil. The diagram (Fig. 1) indicates what combinations may be safely made of some of the more common fertilizing materials.

Various methods have been employed to determine the fertilizer requirements of soils, including chemical analysis, pot experiments, and field experiments. While, as explained in the February 18th, 1911, issue of the SCIENTIFIC AMERICAN in an article entitled "The New Science of the Soil," chemical analysis gives information of very great value in determining the fertilizer needs of soils, the most practical method is to put the question to the plant itself grown in the soils to be tested.

In a simple method employed by the United States



1 2 3 4 5 6 7 8

Fig. 4.—Pots treated with different fertilizers, showing variation in growth of wheat seedlings.

Bureau of Soils the effects of various fertilizers and combinations of fertilizers are tested on wheat seedlings growing on samples of the soil in paraffined wire baskets. (See Figs 2, 3, 4.) The method has the advantage of giving results quickly (in about three weeks) and of permitting almost indefinite multiplication of results.*

* The methods of constructing and using these baskets are fully described in a circular (No. 18) of the Bureau of Soils.

A slower method, but one in which the conditions more closely approach those of the farm, is the plot or field experiment, which consists essentially of applying the fertilizers under as uniform conditions as possible to equal areas of the soil and measuring the effect of the fertilizers by the yield of crops obtained. The fertilizer requirements of many of the soils of the United States have been tested by the State experiment stations, and it is from these that specific advice upon the subject in any given case should be sought. It is possible in an article of this kind to deal only in the briefest manner with a few broad facts regarding the fertilizer requirements of different kinds of soils and crops as brought out by experiment.

As a rule crops grown on soils poor in decaying organic matter (humus) are benefited by applications of nitrogenous fertilizers, while on soils well supplied with humus, phosphate and potash are likely to be beneficial. On heavy soils phosphates are more likely to be beneficial than nitrogen, the reverse being true for light, dry soils. Sandy soils are more likely to need potash than clay soils.

Crops also vary in their fertilizer requirements. For grasses and most cereals nitrogen is considered the ruling or dominant element. It is much less important for leguminous plants, which are able to get a portion of their nitrogen from the air. Potash and lime are especially beneficial to such crops. Turnips, beets, potatoes, and similar crops require an abundance of all three fertilizing constituents in readily available form. Nitrogen is especially valuable for beets, soluble phosphate for turnips, potash for potatoes and other starch and sugar-producing plants. Slow-growing plants like fruit trees do not, as a rule, require quick acting, soluble fertilizers. If, however, it is desired to stimulate growth and fruit fullness, such fertilizers may be used to advantage. Small fruits, making more rapid growth than orchard fruits, require more soluble fertilizers, but otherwise the fertilizer requirements are the same as for orchard fruits. Fruits are generally benefited by potash.

While scientific men as a rule still hold that one of the primary, and probably most important, functions of fertilizers is to supply plant food and to repair the wastes of the soil, more recent investigations, replacing some of the old empirical rules with more exact knowledge of plant and soil, have emphasized the fact that fertilizers perform other very important functions in the soil. We are just beginning to learn how, as well as to what a great extent, they influence the physical conditions of the soil and control the movement of water in soil and plant, correct acidity and toxic conditions, and determine the bacterial activities of the soil.

It has long been known that the presence of a sufficient amount of lime and phosphates in the soil is essential to nitrification, by which inert nitrogen is made available to plants as a result of bacterial action, but it is recent investigation that has brought into prominence the importance of barnyard manure and similar substances as means of promoting and controlling the action of bacteria in the soil. It is a matter of common knowledge that the fertilizing values of manure is not determined entirely, nor possibly mainly, by its content of nitrogen, phosphoric acid, and potash, but by its physical action and by other effects not clearly defined or understood. It now seems clear that one of its most important functions is to supply food to soil bacteria.

Fig. 5.—Plant house used by the United States Bureau of Soils for soil fertility investigations. In the pots fertility tests of different types of soil are being conducted.

Fire Waste and Its Prevention

A Great National Question

By Edward F. Croker, Late Chief of Fire Department of City of New York

A VERY large fire, such as that recently in the Equitable Building, New York, serves to call attention not only to the enormous loss of those directly concerned, but to the vast preventable fire waste occasioned annually throughout the United States. I use the word "preventable" advisedly, for improvidence and carelessness, or worse, in building and maintenance are in large measure responsible for conflagrations, which have been a national reproach for years. Thus in the year 1911 the loss by fire in the United States and Canada was represented by the sum of $234,337,250. Even this large figure has been exceeded more than once. The average for the past thirty-five years has been $148,038,440, while the grand total for the same time would aggregate over five billion dollars ($5,181,345,425). That the annual loss is well distributed is shown by the statement that in 1911 there were 3,410 fires in which the loss exceeded $10,000, and thirty-six in which it was greater than $500,000. If this is not enough, if more figures are wanted, let me add that in the first ten days of 1912 the fire loss aggregated $10,258,000, or over a million dollars a day.

Figures such as these demand careful consideration from everyone. They represent total loss, an absolute destruction and annihilation of value. Insurance serves merely to distribute or transfer the loss. It does not compensate for it either practically or economically. Therefore, at a time when conservation of national resources, even in far off Alaska for example, is a matter of general interest it would seem at least equally important to conserve property, particularly when that property includes the homes of our citizens, the shops of their industries, and the places of their daily business.

But more than property is concerned. Fire carries with it a stupendous death roll, and the conservation of life is far more important than the conservation of wealth. In a single fire—that of the Asch Building in New York last spring—147 lives were sacrificed. This was a so-called "fireproof" building, superior as regards its construction to the majority of buildings in New York and other large cities. The maintenance was bad; there was no fire drill. The result? A disaster of the kind that I have feared for years. In many buildings equally crowded the construction is far worse and the maintenance conditions no better. Is such a general state of affairs, to be tolerated by a civilized community.

Results of a Large Fire.

The Equitable Building conflagration showed how easily the financial center of America can be upset by a single fire. Yet it was common knowledge that billions of dollars worth of securities and legal records of inestimable value were contained in a building of "sub-standard" construction. Such buildings furthermore impair the security of their fireproof neighbors many of which also house vast wealth. The United States Post Office and many bank buildings in New York, Chicago, Boston, and other cities are of no better construction than the Equitable.

Fire protection concerns everyone, rich and poor alike. It is not a simple problem to be settled by a few officials and architects. It affects the city government and its taxes, real estate interests, tenants, architects, builders, business men, and householders as well as firemen and insurance companies. Every one is concerned. While the fire department says the last word in fire protection it must be remembered that it does not utter the first. A good fire department should not have to *fight* conflagrations; it should *prevent* them. Its efficiency should be measured by the small number of small fires not by the conquest of large ones. Prevention is better than cure in fire fighting.

Fireproof Buildings.

Naturally protection against fire can be secured best by fireproof building, but the fireproofing must be real. While it is doubtful if any form of construction would pass entirely unscathed through such a conflagration as that of San Francisco, yet, for all practical purposes, fireproof construction has reached such a point of perfection that reasonable security is provided if builders will comply with certain requirements that experience has shown are absolutely necessary. A really fireproof building is a matter of design and construction. Failure to observe principles now well known has led to disaster in many so-called "fireproof" buildings accepted as such. None but the best fireproofing is good enough, and only the best will survive when the test comes.

Internal fireproof walls should be carried up within any large structure, and floor areas should be restricted and cut off by fireproof partitions and metal or metal-and-wire glass doors. No wood or other combustible material should be used. Metal frames, sash and wire glass should be employed for all exposed openings. Elevator shafts must be inclosed, preferably by wire glass in metal frames with panels not too large. Why? To prevent flames from running up the shaft and breaking out on upper floors, all of which happened in the Equitable fire. All stairways should be cut off at each floor by fireproof doors.

Every skyscraper and large city building must furnish its own fire protection and all tools and appliances for city firemen whose portable apparatus is useless over six or eight stories. This means a powerful pumping plant and system of standpipes with hose reels, extinguishers and other appliances. There should be a complete system of automatic alarms and sprinklers. At the first outbreak tenants, janitors and engineers should be notified immediately and an alarm transmitted without delay to the city fire department, which should respond at once and take charge. Such delay in sending an alarm cost the Equitable Building dear. The installation of one of several alarm systems would have prevented it. Sprinkler systems by which water is released automatically and an alarm given are an invaluable aid and are essential where goods are stored.

Fire Drills of Employees and Proper Supervision of Buildings.

The systematic drill of employees is also indispensable. In a large office building, no matter how fire proof, fire drill is as essential as on a passenger ship, not to mention any large department store or building where large numbers of employees are engaged. As soon as the alarm is turned in to the city department local appliances should be brought to bear, and in well trained hands should be sufficient to deal with any ordinary fire.

In factories and all buildings where the permanent occupancy and where the dangers of possible panic are always present, there should be adequate fire escapes in addition to ordinary elevators and stairways to provide for the rapid exit of the occupants and the quick entrance of the firemen, especially in view of the possible sutting down of the elevators. The stairs should be wide and proportioned to the number of people in the building, for the danger of suffocation by smoke must be considered as well as death by flames. The best safeguards are exterior fire escapes, preferably in towers equipped with standpipes for the firemen.

Aside from the design and construction of a building it must be remembered that a fireproof building filled with inflammable material burns and that a local fire easily may spread to several floors. This was first shown in the Home Life Building and repeated more recently in the Alwyn Court apartment, a building of fireproof construction but lacking fireproof window sashes and frames. A single floor of a modern building has more area than an old-time store. Its goods, too, are far more valuable than the contents of entire buildings in earlier days. Clearly, a local fire is not to be regarded lightly.

Building owners must be forced to supply all possible means of fire protection, and tenants should demand proper sprinklers and alarm systems. But the tenants must observe due caution. There should be no accumulations of waste, no smoking in workrooms or throwing away lighted cigars or cigarettes. Oily belts should be guarded and systematic inspections made by responsible persons within the establishment and by outside authorities.

What can be done by proper supervision of construction and maintenance is shown by New York's lack of serious and fatal theater fires. Protect the poor in the tenements and factories, as well as the rich in the theaters. Let no non-fireproof buildings over five stories be erected, and none for use as schools, hospitals, hotels, factories, large tenements or warehouses of considerable area. Make the extension of local alarms and sprinkler systems compulsory. Put greater restrictions on conditions of maintenance and inspect more frequently and rigorously. Punish the owner, janitor and those directly concerned in any violations. Let there be compulsory removal of all buildings not only dangerous in themselves but a serious menace to surrounding property. There should be no more wooden buildings in congested suburbs or country towns. Fireproof materials of several varieties are cheap enough to render this unnecessary.

Improving the Fire Departments.

The facilities of fire departments should be increased. High pressure systems, such as those of New York, Brooklyn and Philadelphia should be extended to the built-up sections of all large cities. Increased mobility should be given to fire apparatus by the use of automobile machines, but there should be no sacrifice in pumping power to gain high speed. Before the well tried and understood steam fire engine is discarded equal pumping power and reliability should be secured, and this has not yet been sufficiently demonstrated by gasoline motor engines in service, though smaller combination engines have been successful in small cities and rural districts. Motor apparatus gives increased speed especially for long distances, making rapid concentration possible, while at the same time it diminishes expenses of maintenance. While in command of the New York Fire Department I installed the first high power motor hose wagon for the high pressure hose and followed it with a motor tractor for the water tower. Both types of machine have more than justified themselves and have served as models for more recent equipment.

To fight fires successfully requires firemen carefully trained in some fire college or school, of which that of New York is a model. Recently a school has been inaugurated in Newark under the direction of the company of which I am the head. The smaller cities where the firemen have less work to do should have departments highly trained by frequent drills. Every city should have the best possible fire alarm system and one that is thoroughly reliable. Its headquarters or central station should not be in a non-fireproof building as in New York and Brooklyn, but carefully protected. In many cities the systems are good, but in others so bad as to constitute a grave menace.

Conflagration Dangers.

Much is said about the conflagration danger. It is indeed serious in many cities and a proper cause for anxiety. In New York a conflagration is unlikely either in the skyscraper district or in regions of extraordinary hazard and risk on the lower East Side and in the wholesale dry-goods and warehouse districts, protected as they now are by high pressure mains and hydrants. But such immunity is secured only by unceasing vigilance and prompt action with plenty of water and apparatus. Once the fire department is allowed to deteriorate in discipline or equipment and the matter becomes quite different. Some day the skyscrapers surrounding a combustible building on fire may have to defend themselves, but their equipment, aided by high pressure, should pull them through. Fortunately congested districts are not made up altogether of high buildings, and though furnishing hard fighting the fire can almost invariably be confined to the building where it originates.

In conclusion it may be said that everybody must co-operate to save and protect life and property, making sure first that their own dwellings, shops, factories, etc., are maintained in proper condition, and then looking out for sources of danger in their immediate neighborhoods. Good building must be demanded and the elimination of fire traps. All factories must provide for the safety of their employees. Every city must maintain an adequate water supply for fire purposes at useful pressures for the firemen. Finally, every fire department should have legal and practical power actively to prevent fire in addition to being well disciplined and equipped with the most modern apparatus and kept free from politics.

An Expedition to Crocker Land

ABOUT 150 miles northwest of Grant Land lies a region of indefinite extent, which was sighted by Peary in 1906 and named by him Crocker Land. This may prove to be the most northerly land area on the globe. An expedition to explore Crocker Land is now being organized under the auspices of the American Museum of Natural History, and will, it is hoped, start northward next June, under the leadership of Prof. D. B. Macmillan and George Borup, both of whom were members of Peary's last expedition. The party hopes to secure Peary's ship, the "Roosevelt." If possible, the ship will work north and west to Cape Columbia, whence it is planned to proceed to Crocker Land by sledge. The expedition expects to be away from home three years. During the past summer Capt. R. Bartlett made a trip to Etah to arrange for men, dogs and food for the explorers.

The Rural Motor Vehicle

What Gasoline Means in Agriculture

By Ernest Lincoln Ferguson

IN discussing farm life, the trolley has frequently been brought into the limelight as a solution of the isolation problem, but profitable interurban trolleys have limitations on direct ratio to the inhabitants per square mile. The telephone has perhaps deservedly been given greater credit, but even that leaves something to be desired—a voice is only a makeshift for a presence. After all, the much quoted "human interest" sounds its greatest depth in the seeing of our kind; it is the atmosphere of living and of moving surroundings that gives it final zest.

Those who study merchandising by true standards, standards that have their very foundation in the human desires and not in mere calculation of the believed-to-be human needs, know that the automobile knocks down the barriers of distance thus wiping out isolation. By this token it has a permanent foundation for its continued sale. Go into a farming section of large acreage and what is found? In the next county lives a brother or sister of either side of the house. To go by horse-drawn conveyance meant two or three days away from the farm's needed attention and a wearisome journey.

The possession of an automobile means greater frequency of visits and thereby the keeping together of family ties, not a growing apart in ever widening stretches. In modern farming where the acreage is given over to but one or two kinds of crops, thus needing only periodic direct attention it is not a bit infrequent for the owner and family to go on two or three-day trips to remote family connections, the hired man looking after the duties connected with cows and poultry kept only for family needs.

In the east and middle west, unless direct study is given to the matter, one does not realize how much the automobile is a factor in the human contact side of life to break down isolation. In that west of magnificent distances it has been given to those who have crossed the continent in automobiles to find that the automobile has changed conditions for the better. Nothing more completely illustrates this than a trip across Texas made a year ago through the famous big cattle ranch sections, at all times remote from railways and towns. Where three years ago there would have been met the freighters, carrying in supplies for the ranch houses, and the "boys" and the owners on horseback, to-day one sees the freighters and the "boys" as of the past, but the owners are met going forty miles away to the nearest ranch or town in a car, making the round trip in a day, as against perhaps three days.

In Southeastern California there is a 100-mile-wide strip that may well be called a desert. Its two wells are treated with the respect due their importance.

Only the most hardy plainsmen have heretofore occasionally ventured across this stretch. To-day we find the townsman tenderfoot setting across on the average of one automobile a day, thinking nothing of the trip and merely regarding the wells as guide posts *en route*. These daily crossings have brought about an interesting condition. Men who keep in close touch with the nearest railroad settlements by means of automobiles are little by little encroaching on this waste, and thus gradually shortening the mileage between the outer confines of a heretofore dreaded desert.

We find in somewhat more densely settled sections the social elements awakened and broadened by the automobile. Nowhere is this more evident than in the States of Missouri and Iowa. Here we see the very essence of neighborly desire in the various co-operative road associations which voluntarily keep long stretches of natural road in motoring condition by the use of the split log drag. The best known, because of its length, is the River-to-River Road, extending for nearly 500 miles east and west across the entire State of Iowa. This road had and has for its incentive the desire of the automobile-owning farmers along its length to keep in personal touch with one another. Its purpose has so well served its incentive that it now has many miles of parallel and lateral roads maintained in the same voluntary manner and yielding to those who maintain them unmeasured social returns.

From the ownership of pleasure cars by farm proprietors to the use of motor wagons or trucks in farming, there is not the easy transition that would seem a logical corollary. Time was when the thought was general in the land that the two conditions would be automatically brought about by the removable rear-body design, but the faults of this latter construction so militated against its continuance as a matter of manufacturing that there came from it no large results. The use of the pleasure car as a vehicle for farm transportation is to be found here and there, but not in enough instances to make it hardly more than insular. Yet it must be admitted there is a logical sequence from the motor car to the motor wagon or truck on and about the farm.

One has but to travel from the Atlantic to the Pacific to realize how general is the use of pleasure cars, in distinctly farming communities. There has been brought about without definite effort, in fact automatically in the best use of the term, a service upkeep condition based on knowledge that equals in its experience much of that possessed by the men who are sent out by manufacturers from their service departments.

The use of the small automobile truck in farm work is at present so scattered over the United States that its impressment as a whole is not yet felt, nor its importance to the farm so widely appreciated as its value warrants. However, that exception which is supposed to prove a rule is to be found in the farming sections contiguous to Philadelphia. There the small motor vehicle has many users among truck and dairy farmers. Commission houses dealing in fresh produce arrange for the output of certain truck farms. In a case in point one house handles the product of three farms, eighteen miles out. In the past these farms each sent into the city a daily team that started about midnight and that took one man from that farm as a constant factor. Now one small motor truck makes three trips during the night, and the time of two men is saved. Not only is this a definite saving, but peculiar to the situation—and only to be understood by those who have witnessed the dawdling manner in which truck garden wagons are driven to the market and then home again—it has come about that more snap is noticed in getting the produce ready for the motor truck.

The small truck has also brought about solutions of more than the haulage problems. One large producing dairy, twenty-eight miles from its consuming center, has always been puzzled by the problems of shipping by railway or sending milk to distributors in horse-drawn wagons. The latter method has been adhered to as the lesser of the two evils because it kept within the firm's own hands complaints of delays and shortage at the delivery end.

(*Concluded on page 150.*)

This truck makes a trip of over fifty miles every day and does the work of three teams and three men at the cost of two men and one team.

A three-ton truck hauling about 9,000 pounds of milk on the truck and trailer.

A winding mountain road too steep for horses.

A one-ton truck which carries produce and supplies to and from Wheeling.

A three-ton truck shelling corn.

A truck supplying water to traction engines over an area of twelve miles.

A farm truck disking thirty-five acres a day in Oklahoma.

GASOLINE ON THE FARM

How Germany Handles the Labor Question—III

Solving Labor Problems Scientifically

By Waldemar Kaempffert

[This is the third of a series of articles written by the Managing Editor of the SCIENTIFIC AMERICAN *and intended to show the part that science plays in German commerce and industry. The article was written after a personal inspection of German factories and labor bureaus. It seems a far cry from science to the solution of labor problems; yet no other word fittingly describes the systematic and thoughtful way in which German statesmen and manufacturers have sought to deal justly, both with capital and labor.]*

TWO things every normal man wants—something to do and a mind at ease while he is doing it. Translate that into more concrete language, and we get this: Give a workingman work, but also relieve him of worry—the worry that is bred by wondering what will become of him and his family should he fall ill, be disabled, or grow too old to hold his job.

Germany has not discovered a panacea for satisfying these needs of a laborer and reconciling them with the demands of employers. But it has made a brave attempt to reduce the friction in the industrial machinery that may be traced to idleness and worry—an attempt which has proved so far successful that the German workingman may well be considered the most contented with his lot in the world.

Getting Jobs for Idle Men.

If a man is thrown out of work, what can be easier than sending him to an employer who needs him? But, like all easy tasks, that feat is difficult to perform. The first thing is to bring employer and would-be employee together, and this is how Germany attains that end:

Almost every German city, big and little, has a municipal labor bureau conducted by a committee of men who are not mere dreamers, but practical men, who understand that deeds and not theories are wanted —a committee consisting of employers of labor, members of trade unions, heads of industrial organizations, and city officials. To that bureau the idle man goes and makes known his wants. His name is taken down; also such information as may be required as to his past experience and ability. The employer in search of workmen makes known his wants to the same bureau. What is the result? Employer and applicant are brought together, to their mutual advantage. Thus the old idea embodied in the intelligence office is applied in a practical way by Germany to cope not simply with placing domestic servants in good positions, but with finding positions for bookbinders, butchers, paperhangers, housepainters, and mechanics.

Slight variations in the conduct of these labor bureaus may be noted throughout the Empire. Sometimes the workman's name is merely registered, and he is asked to call at stated intervals to ascertain if something has been found for him. In the larger towns he is given a seat in a large waiting room, where he listens to the vacancies that are called out. The city of Munich goes so far as to publish in newspapers and to proclaim in meetings of workingmen and manufacturers the needs of idle men and employers.

Work is not doled out in a haphazard way. A day laborer is given preference to a bookbinder, because there is less demand for unskilled than for skilled labor. So, too, a married man with several children to support is given preference to a single man. The ditch-digger is not asked as to his qualifications for the work of ditch-digging. From the painter, however, from the mechanic, and from the skilled artisan in general, information as to ability and experience is demanded, so that the employer may get the kind of a man that he wants and so that the labor bureaus may not be accused of indiscriminately unloading incompetent men on a busy manufacturer.

Collective Work of the Labor Bureaus.

These labor bureaus work both independently and collectively. Groups of labor bureaus are formed, with the result that all Germany is covered by a net, as it were, to catch the workless man and the employer who needs him. Application lists are exchanged; the postal service, the telegraph, the telephone are freely used by the bureaus to notify one another of their needs. If a man's local bureau can do nothing for him, he is passed along to another bureau where his chances are better. Sometimes he is given a free ticket on the railway; sometimes part of his fare is paid; always a card of identification is given him. What better testimony of the system's efficiency can be desired than the fact that trade unions or guilds have in many cases affiliated themselves with the bureaus?

Not only the mature workman out of employment is thus cared for, but the young boy just out of school as well. Indeed, the schools are asked to send their graduates to the bureaus, so that they may be directed to that calling for which they are best suited. A weak boy is not turned over to a safe-lifting company, nor a boy trained in housepainting to a cabinet maker.

By far the most remarkable of all these labor registries is the *Central Arbeitsnachweiss Bureau* of Berlin, an institution which, while not strictly municipal, is nevertheless subsidized by the city council. In two huge buildings—one for unskilled laborers and the other for women and skilled laborers (union labor at that)—idle men and women are cared for. In the building for unskilled labor you may see not only administrative offices and quarters, but a huge assembly hall with a capacity of about 2,500, a library, a hospital, a restaurant, bathrooms (charge, one penny in American money), workrooms for repairing clothes and shoes (charge for any work, one penny). In the assembly hall a few hundred workless men are seated. An official steps out on the platform and reads to them from a list. Schmidt & Co., in the Augustinerstrasse, want four men on excavation work; Johann Meyer, in the Leipzigerstrasse, wants a porter, a strong man who can carry heavy packages and sweep out the shop at night; the firm of Wilhelm, Schultz & Oberhausen need a hostler. And so the list of vacancies is read out at intervals. The man who hears of something to his liking applies to the director. If he is married and has waited long, he is preferred to the single man who has only just lost his place.

The accommodations in the other building, where the needs of women and skilled laborers are attended to, are similar. They are less ample, because a skilled laborer is usually in demand, so that he needs less help, and because women easily obtain places in factories or homes.

Industrial Insurance.

From the very moment that he obtains employment, the working man and his employer become amenable to the insurance laws; for Germany eases the mind of the workingman as to his future by providing a national system of insuring him against sickness, accident, invalidity and old age, both for the benefit of himself and for the benefit of his widow and orphans.

The insurance premiums against sickness are paid by both employer and employee—two-thirds by the employer, one-third by the employee. Accident insurance is paid for entirely by the employer. The expense of insurance against invalidity and old age is paid half and half, by employers and employees, the Imperial Government providing a subsidy of $10 per insured person, so that the burden may not become too onerous.

When a nation engages in the business of insurance on a wholesale scale we may expect startling statistics. About thirty million persons are insured against accident. Their premiums amount to about $60,000,000, while the reserve is $70,000,000. Equally remarkable are the figures for sickness insurance. About 15,000,000 people are insured against sickness. Their premiums amount to about $98,000,000. No less than 17,000,000 people are insured against invalidity and old age. For this the premiums paid in amount to about $70,000,000, and the reserve reaches the amazing total of about $360,000,000.

Insurance Against Sickness.

Who does the insuring? In the case of sickness, voluntary associations, established in accordance with the law by parishes, societies of factory owners, labor unions, guilds, and similar organizations—all carefully watched and controlled by the State, all managed by boards composed of workingmen and employers. How is the money paid? Very simply. The legal contribution for the workingman is deducted from his wages and paid in by the employer with his own contribution.

What does the workingman get when he is sick? Free medical attendance and medicine, as well as eyeglasses, crutches and other surgical aids, if he needs them. For the first two days no money is paid out. Beginning with the third day, he receives half his daily wages. If he is sick for longer than twenty-six weeks, he is no longer paid out of the sick fund, but thereafter he is cared for by the accident insurance fund. If he does not want free medical attendance at home he may go to a hospital; but in that case those who are dependent upon him receive half of his pay.

Accident Insurance.

The accident insurance premiums are paid entirely by employers to associations of employers. As soon as a manufacturer settles in a district he automatically becomes a member of the employers' association in his district. An injured workman deals with the association and not with his employer, whereby some haggling is avoided. The compulsory formation of associations has proved a boon to manufacturers. They are knit together, so that they profit in a business way from their union; they co-operate, where once they antagonized one another; they meet and study, discuss social problems, of industrial, general, and even public interest. Who can say that the remarkable advance made in German industry and commerce during the last two decades is not in large part attributable to the compulsory formation of these insurance associations?

So generous is the law that even a negligent workingman receives money from the accident insurance fund. Indeed, only the man who has deliberately caused an injury to himself is refused the benefits of the system. For the first thirteen weeks after his disablement the workingman is paid out of the sick fund. After that the cost of his maintenance is charged to the accident insurance fund.

The amount which is paid out in weekly sums from the accident insurance fund is very nicely calculated. The yearly earnings of the laborer are ascertained and the character of his injury. If his earning power has been cut in two, he receives one-half of the maximum weekly pension amounting to one-third of his possible annual earnings. If a man has been completely disabled he receives the maximum pension, which is two-thirds of his annual wages. Very wide latitude is permitted in settling claims. It is possible, in some circumstances, that a man may receive a pension amounting to his full wages. It goes without saying that free medical and surgical attendance is paid for out of the accident insurance funds. In case of death, the widow receives a pension and so do her children. If a woman wage earner dies as the result of an accident, her husband and her children are compensated. Even such distant relatives as parents, grandparents, and grandchildren, if they are dependent upon wage earners who have died as the result of an injury, may receive money from the accident insurance fund.

Insurance Against Old Age and Invalidity.

The business of insuring working men above the age of 16 years against invalidity and old age is carried on by mutual insurance societies controlled by official insurance boards. The actual management of these organizations falls upon representatives of employers and employees. The premiums are paid by buying stamps at the post office, which are affixed to cards. When a card is filled up it is exchanged for a new one.

Before a man can receive a pension for invalidity he must have paid in 200 weekly premiums, and before he can receive a pension for old age, he must have paid in 1,200 weekly pensions. Invalidity usually means total incapacity for work; old age is definitely fixed at seventy. What, it may be asked, becomes of the money paid in for the invalidity and old age fund, if a workman dies and is thus unable to enjoy the fruits of his thrift? The law has foreseen that contingency. One-half of the sum paid in is returned to the injured man or to the dependents of the man who died before seventy. So, too, if a woman wage earner should marry she receives half of the premiums paid in.

Astonishing as it may seem, the large corporations who may employ anywhere from 2,000 to 40,000 men, consider even this admirable system of State insurance inadequate. Accordingly many of them have established independent insurance systems of their own, so that in the case of sickness, accident, invalidity or old age, a workman is doubly compensated—sometimes more than doubly. What is more, some of the firms have taken steps to care for the housing of their superannuated employees. The mere payment of a pension is not deemed enough.

"Does it pay?" I asked a Frankfurt capitalist; "does it pay from a business point of view to spend tens of thousands of marks a year in welfare work?"

"If it pays to oil a machine, it pays to oil a human being," was his delphic answer.

There are strikes occasionally in Germany, but not the constant fear that a plant may be shut down for months because the men are dissatisfied. That, too, is worth taking into consideration. Besides, a man who sings at his bench is more apt to turn out better work than a man who grumbles. "Made in Germany" means goods made by a fairly contented laboring class—contented because their social requirements have been ascertained and met.

Self-lighting orchard heated system showing a 1,000-foot line of pots opening mechanically and lighted automatically.

The Smudge Pot and Its Work

A New Invention to Prevent the Destruction of Fruit by Frost

By Frances Lynne

THE result of many experiments to save fruit trees from frost is the orchard heater or smudge pot of to-day—a simple invention based on scientific, practical principles.

There are any number of different types of heaters—some one has said as many as one hundred. Any fuel may be used, the heater or smudge pot being designed for the special kind of fuel employed. Coal and oil have been the fuels most extensively used, and from the testimony of hundreds of fruit growers in all parts of the country it would seem that oil is held in greater favor because it is more practical and can be handled with much less trouble and labor and with much less expenditure of time.

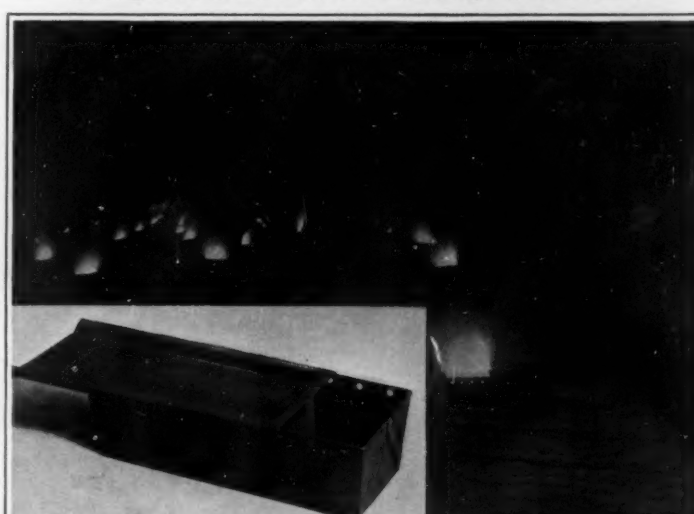
The secret of success in smudging lies in not waiting too long before starting the fires. Everything should be in readiness for prompt action. The torches for starting the fires should be close at hand and properly prepared. The smudge pots or heaters are placed in the orchard as soon as the buds begin to swell, so as to be in readiness for the first signs of a fall in temperature.

Every orchardist has his own tested thermometers, one for about every five acres, hung on a tree; but he also keeps in close touch with the United States Weather Bureau. When the thermometer shows signs of falling, warning is sent from the Bureau to the fruit growers far and wide. At the first sound of alarm, the men are up and doing.

During the smudging time, which often extends over a period of from ten to thirty hours, one man is generally selected as foreman to oversee a certain amount of land, direct the several men under him and keep close watch on the thermometers, heaters, etc. When the signal to light up is given each helper takes a lighted torch and a can of gasoline and begins to draw the covers. As the cover is drawn a certain amount of gasoline is thrown over the surface of the oil, the lighted torch is then passed over the heater and the fuel takes fire at once. Immediately a dense cloud of smoke arises and covers the region to be protected. This prevents heat radiation from the earth's surface and safeguards the buds of the fruit trees from the rays of the sun.

A new self-lighting orchard heating system has been invented which promises to minimize the work incident to the smudging season and prove of inestimable value to the fruit growers. This device may be attached to the various kinds of heaters in such a way that it lights the pots instantaneously with mechanical appliances, thus doing away with the task of lighting each heater separately. So rapidly are the heaters ignited that a vast amount of oil is saved, as it is not necessary with this new invention to light up until the thermometer indicates that frost is in the vicinity.

Refilling oil heaters from a tank on wheels by means of a hose.



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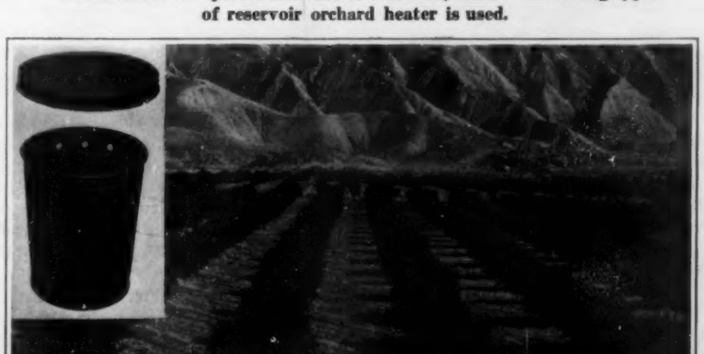
The oil heater in operation in Grand Junction, Colo. The oblong type of reservoir orchard heater is used.



A Colorado orchard which will be saved from frost if necessary by oil heaters. The insert shows the round type of oil heater.

THE SMUDGE POT AND ITS WORK

By means of the self-lighting equipment a line of a quarter of a mile of smudge pots can be lighted instantaneously. It may be attached to any style of smudge pot now on the market, the overhead system being used to operate the round style of pot and the ground system for the oblong heater. The illustration shows the system equipped on the round and oblong types of pots. The system, when operated with the round pot, consists of two overhead wires running down through a row of trees from a post, with reel and lever attached, to the end of the orchard. The overhead wire, which is erected about seven feet from the ground, may be conveniently run through the limbs of the trees or between rows as desired. From the overhead line a wire extends to each pot lid, which connects with a chemical cartridge placed on a holder attached to each pot. This wire is made in two lengths, a long and a short, the object of this being that when the lever is turned once around every other pot is mechanically opened and the self-lighting chemical cartridges are brought into position and lighted instantaneously without any further operation. When the cartridge is opened, blazing gasoline flows therefrom onto the crude oil. Upon a second turn of the lever the intermediate pots are opened and lighted. The system is designed upon this construction for the reason that when a minimum amount of heat is required the number of smudge pots in operation is only every other one throughout the orchard. If the temperature requires additional heat it is immediately obtainable simply by an additional turn of the lever, and the full number of pots are put into instantaneous operation. The rapidity of the work and the economy of oil is self-apparent with this method of operation, for it is entirely unnecessary to light up an hour ahead of frost.

In equipping an entire orchard with the self-lighting orchard heater system the levers are placed in a centrally located row so that when smudging time comes, all that is necessary is to throw the series of levers and the whole orchard, within a few minutes' time, is ablaze with smudge pots to meet any needs of temperature. The chemical cartridges are renewed at the time the pots are refilled and the entire smudging apparatus is then all ready to overcome the next frost.

The self-lighting system when adapted

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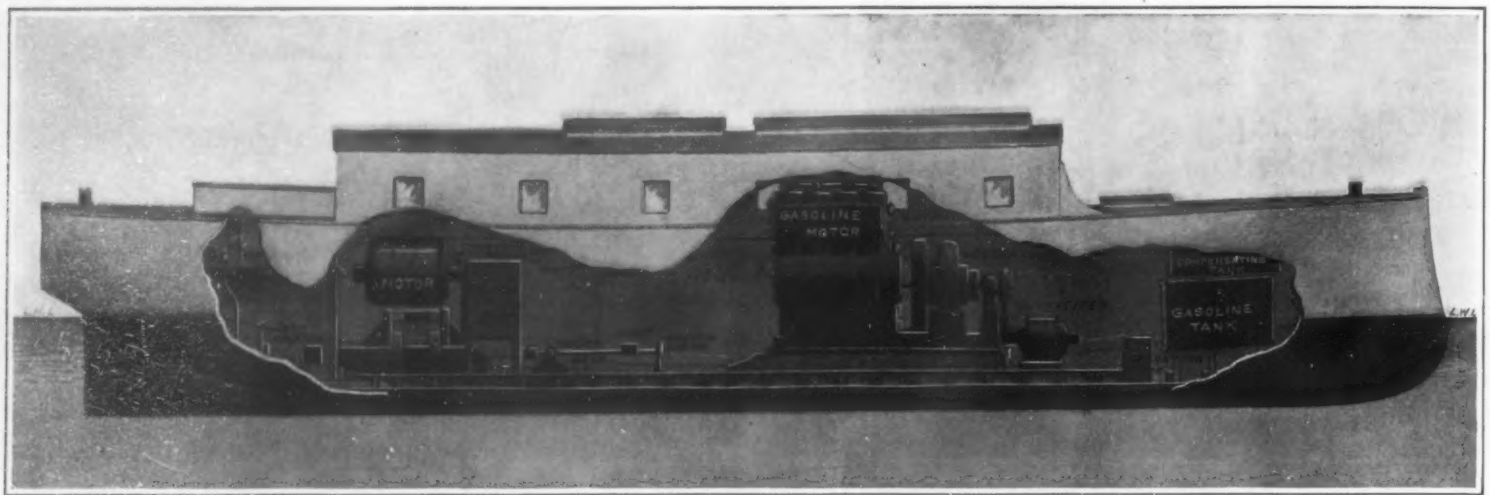


THE "FROUDE," A GASOLINE-DRIVEN VESSEL WITH WHICH THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY IS CONDUCTING HIGHLY INTERESTING AND SCIENTIFICALLY VALUABLE EXPERIMENTS

The Model Boat "Froude"

Studying Naval Architecture in a New Way

By John Ritchie, Jr.

A COUPLE of seasons' work by Prof. C. H. Peabody and his assistants at the Massachusetts Institute of Technology with a little vessel, the "Froude," has served to throw a great deal of light into an obscure corner of ship construction. One of the matters which Prof. Peabody has been studying is the relation of the propeller to the hull. A great deal of work has been done by many observers in experimenting with shapes of vessels and propellers in tanks and the like, but it has remained for the Institute to carry out a pretty complete and definite set of investigations with reference to the mutual relations of the two.

This may seem to be a very odd subject for a land college to be taking up, that of the behavior of steamships, but after all, it is to be remembered that engineering whether on land or on sea is very much the same profession, and that naval architecture and marine engineering constitutes one of the important departments in the famous Massachusetts school. So high does the department stand in the opinion of those competent to judge, that it is attracting students from important maritime nations, that China and Japan send each year their men to take the courses in naval architecture, ensigns and even higher officers of these navies being not very rare, while the Department of the Navy of the United States requires every naval constructor to take a three years' course at the Institute following the courses at Annapolis. So much for the Institute and its relations to the sea.

Dr. Charles G. Weld, recently deceased, an enthusiastic Massachusetts yachtsman, realizing some of the difficulties in the situation and knowing that a series of rigidly scientific tests would be expensive, offered to defray the costs of such work, which at the time of his death had resulted in tests with one boat, the "Froude." It was Dr. Weld's idea that experiments could be conducted with model boats moving under their own power which would yield valuable results. He consulted with Prof. Peabody, and undertaking to finance the experiments left the execution of the plans to the Technology professor. The result was the construction of the "Froude," which, being a vessel for scientific experiment, was built, equipped and cared for in a way very different from what would be customary in a war vessel or one for commercial purposes. For the "Froude" is a floating laboratory, filled with the means for testing everything that should be known about a steamer.

In the first place it is an exact model, one-fifth of the scale, of the revenue cutter "Manning," a type and a vessel that were deliberately chosen. The "Manning" had already been tested by Prof. Peabody, and there was the evident opportunity of determining by a series of similar investigations with the small ship just how closely the results would be concordant. The agreement was found to be excellent, and the question whether a model will give reliable results throughout proper testings has been settled.

The little boat contains a gasoline motor directly coupled to an electric generator, the current from which operates a motor which in its turn is connected by chain-drive to the propeller shaft. There is here the opportunity to make a number of measurements, each one at some definite stage of the work. The boat is fitted with a water tank which can be filled just enough to secure the propeller shaft. There is here the opportunity to make a number of measurements, each one at some definite stage of the work. The boat is fitted with a water tank which can be filled just enough to secure the draught desired and the proper trim. It has marks painted on the hull to indicate the draught, and a number of sights are arranged so as to show if the hull should change its shape. The bottom of the boat has been painted frequently, so that it should always be in about the same condition with reference to friction with the water, and on its trips it carried only the proper crew, Prof. H. A. Everett of Technology, and an assistant.

The general arrangement of machinery is shown in the illustration. The thrust block, too small to be represented on the scale, has the novelty of having the shaft go through it, instead of being at the end, the thrust being given by a single collar. The operating tank is that which contains the small supply of gasoline for immediate use, being filled from time to time from the larger tank, after which the compensation tank is so loaded or lightened as to give again the proper draught and trim.

In the mechanical parts some of the items were designed at considerable trouble and cost so as to make the results more accurate. The thrust block, for example, was provided with ball bearings, so that practically all friction in that quarter should be eliminated. This block is an important item in the construction, for it takes all the push of the propeller and transmits it to the hull. Then again the shaft-log, which is the bearing through which the propeller shaft projects back into the water at the stern of the boat, is in the "Froude" made so free of friction that there is a possibility of water leaking into the hold. To avoid this oil under slight pressure is used to fill the log, the oil oozing a little when the boat is under way. This is a new idea, one that is, however, not practicable in commercial work. These details as sketched will serve to show with what care all the matters were considered that could affect the accuracy of the scientific results.

The "Froude" was tested over a course a quarter of a knot in length, at times half a knot, in the Charles River Basin, precisely in front of where the Institute is presently to have its new home. The locality is an ideal one, with sufficient depth of water, and absence of so many of the factors that make for uncertainty in sea or river runs. There are no tidal flows and no currents, the only movement of the water being from purely local conditions, and to avoid some of these, notably disturbances from other vessels, the testing runs were taken early in the morning, from four o'clock till eight.

The chronograph for taking the records was developed by Prof. Everett by extending and adapting the familiar form, a cylinder moved by clockwork on which a number of pens make tracks. In this instrument, however, the motor is an electric one and different speeds are available. The object of this is that the records for the different runs may be of the same length and thus easily comparable. The runs are at different speeds and it is necessary, therefore, to adjust the movement of the chronograph to correspond with that of the boat. In such a recorder the pen jumps aside from its regular line, showing the time at which something occurred, while a time-pen jots down its notches on the same sheet, thus showing the moment at which the something did occur. A number of elements may thus be noted on the same strip of paper, usually the number of turns of the propeller, the amount of its thrust or pressure on the thrust-block, which is weighed directly, and the time. Other pens are at hand for noting other matters such as the beginning or end of the run, etc.

The first season the "Froude" was in the water, that of 1910, much of the time was devoted to trying out the little boat and finding out what its limitations were. It was evident very quickly that it was a ship. It behaved exactly like a ship and not at all like a steam launch. When the work of the season of 1910 was reduced to terms that could be compared with other investigations, it was evident that the results were very accurate; in fact, with less than one per cent of error for tests at full power and speed and two per cent at the lower speed of four knots. There was also the gratifying evidence that testing in a model, if properly done, yields results valuable in the larger ship. The workings of the larger vessel may be foretold by the behavior of the little boat. This is a distinct advance over previous positions, for in the "Froude" for the first time all the relationships of length, draught, tonnage, power and speed were consistent with the same elements in the "Manning," the only difference being that it was impossible to procure a lilliputian crew and that the engineer and record-watcher were ordinary-sized men.

Some of the experiments of the first year had to do with the wake and allied phenomena. The wake follows the vessel and has a tendency to push it ahead, but on the other hand, there is a suction in the water, which the engineers term "thrust-deduction," due to the action of the propeller, which tends to hold the vessel back. It has been possible with this little vessel of Tech's navy to give more accurate values to these two elements, and with the delicate means at hand for measurement, it was found that the thrust-deduction might under some conditions become a push to the vessel instead of a pull and help the wake in sending the boat ahead with greater speed. These are small matters, it is true, but in the construction of vessels as in other matters of life, it is oftentimes the small matters that give clue to the larger ones.

The work of the season of 1911 with the "Froude" in the Charles River Basin has been largely with the propeller. As in many other lines of business, the marine engineers have had favorite forms which they have adopted and for which they are ready to argue the special merits. Little differences in pitch or form of blade have been the sensible differences between makers. The "Froude" has settled the matter by tests with three forms of propellers, one the conventional type and the other two extremes of a form so different from the usual that no propeller-maker would think of using them. In the tests all three have produced results practically the same. It may therefore be said, that if the propeller is well chosen for the ship in its other proportions, the particular form in point of shape or pitch matters little.

One of the advantages possessed by the little Technology steamer is the ability to place the propeller at different distances from the stern post. In the regular

(Concluded on page 140.)

The Curtiss Flying Boat

Description of an Improved Type of Hydro-aeroplane

By Frank T. Searight

THE latest and biggest wonder in the world of aviation was tried out by Glenn H. Curtiss last month at his San Diego, Cal., public aviation school, and has proved a success beyond the expectations of its inventor. This new hydro-aeroplane is known as the "Curtiss Flying Boat."

The "Flying Boat" resembles the Curtiss hydro-aeroplane, now in use in the navy, only in that it has a similar set of planes and that the boat is like the float of the latter to some extent.

It differs in that it carries a passenger as well as an aviator in the boat, is of 60 horse-power, has a speed of fifty miles an hour in water and sixty miles an hour in air, contains bulkheads fore and aft, has an automatic starter, fuel gage, bilge pump, and spray hood for the engine (not shown in photo), and that it is driven through a clutch and chain transmission extending to twin propellers.

The new machine differs from the old hydro-aeroplane in that it is a "headless" biplane with only a rear control. It also has two propellers placed in front of the planes, and driven by chains from the motor, instead of one behind on the engine.

The "Flying Boat" is capable of standing any wind or wave that any boat of its size will stand. The boat part of it, which tapers at each end, is 20 feet long by 30 inches wide, and 4½ feet deep. It has a cockpit in the center 2½ square feet in size.

The advantages claimed for the "Flying Boat" are its safety, quickness to rise from the water, and that it is comfortable and can be operated like a boat.

The new air-water craft was tried out for balance and speed on water and worked perfectly. Mr. Curtiss stated, however, that work on it so far has been experimental, and further experiments will be made soon before it will be considered a finished type.

The try-out was on the Spanish Bight, a part of San Diego Bay, which has made the Curtiss camp an ideal place for experiments with such craft; outdoor conditions have been so good there the winter through that the "Flying Boat" was set up in a canvas hangar on the beach, and thus easily launched.

Three-quarter front view of machine at rest on the water.

Side view of flying boat, showing position of man and motor.

Capt. Capalini. Lieut. McClaskey. Mr. Curtiss.

Glenn H. Curtiss and some of his pupils.

THE LATEST AMERICAN HYDRO-AEROPLANE

New Points About the Kola Nut

THE kola nut is much esteemed by the natives in the parts of Africa where it grows, on account of its valuable stimulant and medicinal properties, and it occupies a large place in African legends, as well as in ceremonies and cults. All these tribes have been aware of its stimulating properties from time immemorial, and it is also used as a remedy for marsh fever and many other maladies. M. P. Guerin, of the Paris College of Pharmacy, brings out a number of curious customs in which the kola nut figures. It is used as a pledge of friendship or affection, as an offering to fetish men, and also as money or for paying tribute. In the Bambara and other regions, a young man sends a basket of white and red kola nuts to the father of a young woman whom he desires to marry, and if the father consents, he keeps all the nuts, but if not, he keeps the white ones and returns the red. The natives offer the white kola nuts as a gift to foreigners, as the white nuts are held in greater esteem than the red, but if they have none of the white they offer the red. In the whole of the Soudan region the kola nut is a symbol of friendship, and as it is an article of luxury, the act of offering it as a gift is taken as a mark of the wealth of the giver. Eating the kola nut together is a sign of friendship, and it would be a great offense to refuse to do this. Treaties, vows or compacts are made binding in the same way. The kola tree is much respected, and M. Chevalier cites as an example the fact that he wished to secure some very fine flowers from a kola tree growing in a small village, but the chief did not dare to allow him before assembling some of the old men and other principal persons, and even then none of them would pluck the flowers. They allowed him to do so, but said that this would bring him bad luck. Among the Bagas, a tree is planted at each birth or notable occasion. In the Diorugu region when a chief goes through the ceremony of naming his child, he plants a kola tree, and this afterward belongs to the child. When a tree is planted on the tomb of a chief, his son possesses it, and such a tree is supposed to grow more rapidly. In other cases when a native wishes to communicate with a dead person of his family, he pours water on the tomb in which kola nuts had been placed. The trees, at least, in the coast region, are usually owned by individuals and pass to others by heritage like other property, but among the Dans and Dyolas only the chiefs and principal persons can own them. On the lower Ivory coast, the trees are the object of a sort of ancestral cult, and are not allowed to be cut, being held in great respect. Although the stimulating properties of the kola nut are well known, there has been some doubt up to the present as to what principles are the cause of this action. Besides, as the nuts are imported from Africa they are apt to arrive in the dry state, and the dry nut has but little value. The natives consume large quantities of the fresh nut, but will not use the dried nuts. M. A. Chevalier figures the yearly production of French West Africa at 5,000 tons, and to this is to be added the production of the English colonies. While the fresh nut is an object of commerce in different African regions, only the dried nut is imported to Europe, at the rate of about 1,000 tons a year. A native in Africa will eat 600 or 700 kola nuts in a year, making about 25 pounds weight. This amount is limited only because the kola is rare and has a high price, owing to the difficulty of transporting it in these regions. The development of railroads would be of great benefit to the kola trade. Experiments have recently been made to determine what principles cause the stimulating effect. In the fresh nut M. Goris found in addition to caffeine, two new principles, kolatine and kolateine, and he shows conclusively that the dried nut has very little power to sustain the vitality of the system and prevent fatigue, such as is displayed by the fresh kola. The kola tree bears some resemblance to a fruit tree, and has handsome white flowers. A tree will bear an average of 600 nuts a year under good conditions. As the result of the above researches we are to conclude that the dried kola nut should be no longer imported, especially as the fresh nuts can be easily transported in fiber packing. The nuts can be kept fresh by putting them in layers in 1 or 2-pound tin boxes, and they will thus last for several months. Messrs. Goris and Arnould, of Paris, have found a very good method of sterilizing the fresh powder so that it will keep indefinitely.

A Sleeping Fish

SOME curious habits in a fish have been observed by the French zoölogist, B. Romeis. The fish in question, which bears the name *Paratilapia multicolor*, was kept in an aquarium containing suitable seaweed, and observed through several seasons.

The female fish places the eggs in pockets in her mouth, and keeps them there until they hatch. After hatching, the fry is thrown out into the water in the morning, but toward evening the young fish come back to the mother's mouth, inside of which they spend the night.

A resting condition resembling sleep was also observed. Ordinarily these fish rest near the bottom of the water. But after the eggs are laid the female seeks the surface of the water, so that at times her back fins were actually out in the air. When at the surface, she pressed her side fins close against the body, and remained quite motionless for as much as two hours at a stretch. With the exception of very slight movements of the gill covers, there was nothing to indicate that the animal was still alive.

Dr. Romeis supposes that the advantage in this habit lies in the fact that the female having eaten no food for a long time (during the breeding season) and being obliged to economize the reserve fats in her body, avoids motion as much as possible. Floating near the surface is perhaps connected with the fact that here the fish can get sufficient oxygen with the least amount of exercise.

Milan's New Water Supply System

INASMUCH as springs are too long a distance from Milan, that city has lately reorganized its water supply system by boring artesian wells on the spot and going down to 200 feet depth. At present there are upward of 70 artesian wells bored and a good water supply is thus afforded. This accomplishment led to the building of a number of water works for feeding into the city mains, and eight stations are now operating and nine are building for this purpose. For operating some of the pumping plants, Diesel oil engines are used, while others use steam engines. Electric motors are also employed for a number of them.

Curiosities of Science and Invention

Vienna Auto Fire Engine

THE accompanying engraving illustrates a radical departure in fire fighting apparatus. It consists of an automobile, which has been remodeled to make of it an efficient fire engine. The engine which propels the vehicle may be connected to a water pump with three hose connections so that three lines of hose may be served. The pump is of the centrifugal type and delivers a thousand liters (264 gallons) per minute. It was recently used at a big fire in Vienna, and stood the strain of continuous work for twenty hours. The apparatus may draw water from three hydrants and may be used as an auxiliary for two steam engines. It drives the water a distance of 500 feet. The apparatus carries a quantity of hose, also a number of ladders, which are supported on frame above the driver and crew.


Vienna auto fire engine and hook and ladder.

The Miner and the Canary

OUR title suggests a fable after the order of the "Lion and the Mouse," and no doubt a modern Æsop could construct a very pleasing tale with a telling moral based upon the important part that the canary now plays in warning rescue men of the treacherous fire damp. About fifteen years ago Dr. John Scott Haldane, who had studied conditions in Cornish collieries, suggested that canaries could be used to advantage for detecting poisonous gases. These delicate birds are very susceptible to impure atmosphere, and can thus be used to give a warning before a man feels the slightest discomfort. The first test of canaries in a real mine disaster in this country took place at the Cross Mountain mine explosion at Briceville, Tenn. Here the government rescuers, equipped with oxygen-making machines upon their backs, and carrying caged canaries, were followed by squads of unprotected volunteer rescuers. The birds were watched, and as long as they remained cheerful, all was well; but when their wings began to droop and they gasped for breath, it was known that the men without oxygen machines must venture no farther. The canaries drew the line of safety, and as a result no volunteer rescuers were exposed to the dangers of after-damp.


Canaries as mine-gas testers.


Gravity chute of a keg conveyor.

The Oratory of Gallerus

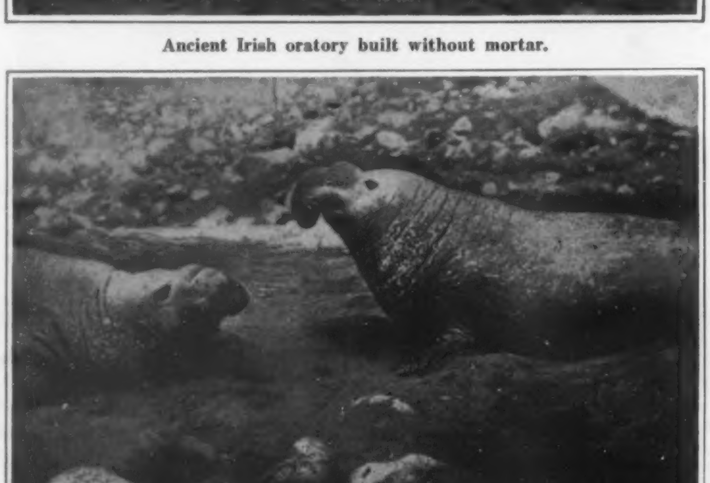
SCATTERED about throughout Ireland are many stone houses dating back to pagan times, or to the day when Christianity was first introduced into the island. Most of these structures are badly dilapidated, or in ruins, but now and then one comes across a building that is in a state of almost perfect preservation, and forms a lasting monument to the skill with which the walls were constructed. No lime was used to hold the stones together, which renders their preservation all the more remarkable. Probably the most beautiful of these monuments is that of the Oratory of Gallerus, on the Dingle promontory, in Kerry, which, with the exception of the stone crosses that have been knocked down from the gables, is now in a perfect condition. The oratory is built of green stone, quarried in the neighborhood, and measures 23 feet in length by 10 feet in width. Its extreme height is 16 feet. The walls are about four feet in thickness at the base. There is but one door and one window in the structure. The door measures 5 feet 7 inches in height, and 2 feet 4 inches in width at the base, tapering to 1 foot 9 inches at the top. Following the usual custom, the door is situated in the west end-wall, while the window is in the eastern wall. There are sockets for the two crosses at the top of the gables.


Ancient Irish oratory built without mortar.

The Elephant Seal

ONE of the noteworthy results of a recent expedition on the government steamer "Albatross," was the discovery of a band of elephant seals. The expedition was commanded by Dr. Charles H. Townsend, Director of the New York Aquarium, and was sent out under the auspices of the New York Zoological Society and the Museum of Natural History, New York. The animals were found on the uninhabited island of Guadeloupe, 250 miles off the coast of San Diego. The party captured alive six baby elephant seals, which were sent to the New York Aquarium, where they are attracting great attention. Four skins of large adult males were obtained, over sixteen feet long, for a museum group. The accompanying photograph clearly shows the remarkable elephant-like proboscis, as long as the head. The maximum length of the adult male is 22 feet. The female, which is smaller, lacks a proboscis. The short proboscis, or "trunk," has the nostril openings at the end and can be expanded and contracted at will. The male elephant seals fight desperately, as the scars on their necks and breasts bear evidence. They have formidable teeth and send forth guttural roars which can be heard at a considerable distance. Unlike the fur seal the elephant seal is a wonderful oil-producing animal, having a deep layer of blubber six or seven inches thick; the oil is even superior to whale oil.

Fifty years ago, elephant seals were abundant, but owing to their wholesale slaughter to obtain the valuable oil for commercial purposes by the sealers, the species is now approaching extinction.


The elephant seal, so named for its curious proboscis.

Handling Kegs With a Wire Cable Conveyor

A MODERN wire cable conveyor for handling kegs has been installed at a factory in Youngstown, Ohio, for carrying empty kegs from the cooperage plant to the rod and wire department of the works. Until recently it was necessary to carry the empty kegs by hand into the cars of the cooperage plant and transfer them to the packing room some distance away, but this was slow and expensive.

A light steel bridge on which the conveyor is mounted extends a distance of 152 feet from the cooperage plant to the rod and wire department. A gravity discharge chute is used at the delivery end of the conveyor. This is shown herewith.

A 3½-horse-power motor drives the conveyor, which travels at a rate of 60 feet per minute, giving the conveyor a capacity of 9,600 empty kegs for an eight-hour day. By the use of this conveyor it is possible in about two hours' time to transfer sufficient kegs to keep the nail department supplied for twenty-four hours and the kegs are handled with less breakage and are deposited right where it is desired to use them, while the conveyor is equipped with an automatic counter which gives an accurate account of the number of kegs handled.

Temperature and the Color of Fish

EXPERIMENTS have recently been conducted to determine the influence of temperature upon the pigmentation of fish. The general result, as hitherto accepted, is that an increase of temperature tends to produce a contraction of the black pigment cells, whereby of course the surface color is reduced in darkness, while conversely, lowering temperature tends to darken the appearance of the fish. In a series of more recent experiments Von Frisch has exposed only a limited area of the surface of the fish to the temperature applied. Under these conditions he found the effect reversed, heat causing expansion and cold contraction of the pigment cells. The action was found to be local and independent of the blood circulation. Severing the spinal cord does not destroy the effect, but it is not yet certain whether the influence is due to direct action on the pigment cells or to a reflex action through the sympathetic nervous system.

The Rural Motor Vehicle

(Concluded from page 133.)

Regarding as a constant the time consumed between the dairy and the point of delivery, the variant became the load to be carried. This, however, was merely a matter of horse-power of engine and size of body. The interesting point that has been worked out is the construction of the body. On each side of a center aisle are tiers of compartments. The top few inches under the roof are packed with ice. Syphon cooling is maintained as on the transcontinental railway fruit expresses. By the use of the motor vehicle in this method all the advantages of shipping by milk train are had and the advantages are secured of direct delivery to the distributors.

Unfortunately there are no accurate figures showing the comparative costs of operating vehicles within the capacity ranges of one-half to one and one-half tons, as between the horse and the gasoline vehicles. This particularly applies to such as are used for farm work. The main appeal is the saving of time, for time, or rather the moment of delivery, frequently spells a difference in profits secured. In fact it may be well questioned whether or not exact figures can ever be arrived at for farming comparisons.

Setting aside the tractor gang plows of the northwest wheat fields, tilling of the soil by motor has reached only small proportions and these mostly in England. Occasional instances have been published where the automobile has been rigged up to saw wood and other similar jobs about the farm, but those have always come from personal initiative. As these instances widen it is not too much to expect, at least in prophetic spirit, that tilling usages will come, but from the initiative of personal ownership rather than from concerted effort on the part of the manufacturers, the varying conditions presenting a not attractive field to well-regulated factory practice.

The elimination of the horse on the farm in hauling, if not in tilling, will increase the effective acreage for man's food products by just so much as it cuts down the acreage needed for raising feed for the horse. This added productiveness on any farm must count in favor of the automobile in comparing its cost with that of horse maintenance.

With the constantly increasing co-operative marketing of farm products, there comes into play the large truck. Here the problem measurably approaches the haulage conditions of large business houses in the cities, the one difference being that in its connection with large farming operations the truck would probably not be in use for so many total days in the year. Unlike the case with the smaller truck, there are to be had many lists of figures showing the costs of hauling, as applied to the large trucks with a capacity of three tons and over. The quality of these lists vary from general statements to careful analysis where every item is given, based generally on experience, covering gasoline; oil; grease and waste; wages; storage; depreciation, varying from 15 per cent to 20 per cent; interest; taxes; insurance of all classes; periodic inspection; overhaul and current repairs, and tires based on a flat renewal of one set per year, or on a continuous mileage guarantee. Taken as a total the sum of these items for each year about equals the first cost of the truck where it is in use for a full day on all working days of the year. It is therefore obvious that the cost per day is nearly fixed and the cost per ton for hauling must vary with the load weight per trip.

In large farm work there would be a considerable difference from the above total, because, as with all farm machinery, there would be considerable periods of rest. This would mean that the only fixed figures would be those applying to interest, insurance and taxes. All the other items would change, some in direct proportion to the time used and others would depend on the locality for their ratio of change. On the whole, the motor truck, of any size, on the farm will soon come to be recognized in the same light as is now all farm tool machinery. Its first cost and the immediate costs of operation will be minor factors in face of the volume, combined with dispatch, of the services rendered while in operation.

The Smudge Pot and Its Work

(Concluded from page 135.)

to the oblong type of pot is in principle essentially the same, a slight difference being made in the arrangements of the connecting wires. The heaters are placed in the orchard at required distances and from a lever extend two parallel wires attached to the lid of each heater, and so on from heater to heater to the last tree in the row. A self-lighting cartridge is placed upon a holder attached to the end of each heater and also connected with the lid of the heater by means of a hook. The reel at the end of every row of heaters is constructed with a gage which regulates the size of the opening of the heaters. By turning the lever to the first point the lids of the heaters are opened a distance of three inches and simultaneously with this operation all of the heaters are lighted, thus giving a minimum amount of heat on the entire line. If the temperature is to be raised the lever is turned to the next point and all of the lids of the heaters are opened two inches wider. If this opening is not sufficient, another movement of the lever throws all of the heaters wide open and the maximum amount of heat is obtained.

The self-lighting system on this type of heater is also arranged with mechanical means of closing the lids on each row by a single operation should the temperature have been raised and a lesser degree of heat be required. This arrangement is designed to give to the operator perfect control over every line of heaters in opening, closing, lighting and extinguishing by mechanical devices, thus doing away with manual labor as well as effecting a large saving in oil. Thus, by the convenience which this self-lighting system affords one man can operate a large acreage of orchard heaters.

The self-lighting cartridge which is the medium of igniting the pots is of simple construction. It is made of treated paper and consists of self-lighting chemical agents placed in a tube within the container. The space surrounding the tube is filled with gasoline, and a sealed cap covers the container. The operation of the cartridge is accomplished simply by breaking the cover seal, which is done automatically as the lid of the heater is thrown open by the lever. The chemicals burst forth with a large flame, and simultaneously the blazing gasoline in the cartridge flows out upon the crude oil in the heater and in turn ignites it. The cartridge never fails to light. The cartridge is made of treated weather-proof paper, to reduce the cost of manufacture. When one cartridge is used it may be readily removed and another attached.

Last year nearly $3,000,000 dollars were at the mercy of frost in Colorado alone. The residents of Grand Valley meant business, held a mass meeting at which over 900 business men and orchardists participated. The latter told of the efficacy of smudging and the success with which they had met in the use of orchard heaters. A square block of the city of Grand Junction was covered with smudge pots of different varieties and designs, and numerous demonstrations were given.

A $3,000,000 fruit crop is not to be sneered at. So the railroads, oil and fuel companies promised co-operation, while the trades and labor assembly also lent assistance.

The Model Boat "Froude"

(Concluded from page 136.)

steamers there is only one place—that planned for it by the builder. The construction does not permit of its being moved. Prof. Peabody accordingly had trial runs made with the propeller placed

in different relations to the hull, and at a distance of six inches from the sternpost he found an increased efficiency of twelve per cent. This means plainly that in vessels of the type of the "Manning" there would be increased efficiency in placing the propeller farther away from the hull. Of course it is not possible now to alter such vessels, but it will be an important consideration when others of the same type are designed. The result is also suggestive that with other forms of hulls better positions for the propeller may be determined. It is in just such a connection as this that the "Froude" has been of the greatest benefit, for it has shown the possibility of predicting with a comparatively inexpensive model the actual performances of the large vessel.

The portion of the work of the Tech navy that is of immediate popular interest pauses here for the moment, but there is a deal of information useful to the ship builder that must be expressed in technical language. There have been taken up a number of comparisons. One of these is with the "Froude" with the propeller removed, and still another series was made with a model of still smaller scale. A little boat one-eighth of the "Manning" in scale was built at the shops of the Institute and sent to Washington to be tested in the great towing tank. Thus there were obtained a number of collateral lines of investigation. Both the "Froude" and "Manning" may be compared under their own means of propulsion, or each may be compared with itself when moving itself and when being towed, and again when being towed with the smaller model when towed. These comparisons are of great importance. They throw light on technical questions of friction with the water, which have always been very hard to determine.

A month ago the story of the scientific navy of the Massachusetts Institute of Technology, a very creditable one, rested here, with the presentation of the technical details to the Society of Naval Architects and Marine Engineers, for with the death of Dr. Weld, his support ceased. The whole matter is, however, one of such interest that it is hardly possible that it should be given up, for the results have been so satisfactory, that the need of testing other forms of vessels, those of commercial importance, has become evident. For the coming year, support has very recently been assured by two New York gentlemen, interested in yachting, Mr. Arthur Curtis James, an enthusiastic yachtsman, and Mr. Clinton H. Crane, the well-known yacht designer. The experiments will, therefore, be continued during the season of 1912 as before, and with the tugboat model, for which the donors of the fund have expressed a preference. This model is to be built in the Technology shops. There are also other commercial forms, like the coastwise steamer which may well be benefited by investigation, for truly but little is known about them in a scientific way, and these may in turn be discussed in the same calm and scientific way that has characterized the observations with the "Froude."

Atlantis Again

NOTHING has been heard of Atlantis, the lost continent, for a number of years. Plato's story of the powerful empire, the cradle of civilization, which extended far westward from the Pillars of Hercules, and which was finally destroyed by some sudden and stupendous cataclysm, is, of course, comfortably ensconced in all the encyclopædias; but the modern attempts to substantiate the story on geological, anthropological or other grounds belong especially to the literature of a generation or so ago.

Like a ghost from the vanished youth of those of us who have reached middle life, the scientific Atlantis has risen again from its quasi-oblivion. In a short note contributed to the *Comptes Rendus*, M. Louis Germain gives some advance information concerning a book he has in hand which will trace the veritable history of Atlantis on the evidence of "ethnography, anthropology, geology, paleontology, botany, and zoology."

As in other similar undertakings, the new history of Atlantis identifies the Azores, Madeira, the Canaries and the Cape Verde Islands as the last remnants of the vanished continent, and proceeds to trace the resemblances of their faunas and floras, living and fossil, with those of Europe, Africa and America.

Photographs in Natural Colors on Paper

By the Paris Correspondent of the Scientific American

A GREAT stimulus was given to photographic work by the production of the new autocrome and other color plates. Instead of the usual black and white photographs, amateurs are now able to obtain views in brilliant colors, and the effect is a most pleasing one. However, with the color plates, it was only possible to have glass plate views of an object. There was no way to make colored prints on paper from the glass plates. This was, in fact, a most interesting problem which remained to be solved, and it naturally marks the next step in advance in photographic science and invention. It is gratifying to note that the problem of obtaining colored prints on paper from color plates has been solved, at least to a certain extent, by a prominent scientific worker, Dr. J. H. Smith, who has devoted a number of years to this fascinating research. I had occasion not long since to call upon the inventor at his laboratory in Paris, where he is now engaged upon the question, and he showed me a number of remarkable color prints upon his special paper. These prints were made from glass autochrome color plates by printing in an ordinary frame in the sun. The new paper is already being placed on the market. Dr. Smith furnished me with the following points on the subject:

The method which he uses depends upon what is known as the "bleaching out" process. While we are all familiar with the fact that colors will fade out when exposed to light, and this is more rapid in strong sunlight, it may not be so well known that the fading out of dyes depends upon the color of the light which strikes them. A paper dyed with blue, for instance, will not fade out when exposed to the sun under a blue glass, but when exposed under a red or yellow glass its color is bleached out more or less rapidly. A red dye is not bleached under a red glass, but the other colors act upon it, and it was found in general that any dye was protected by a glass of the same color, while the other colors bleached it out. This action of colored light upon bodies seems to have been first commented on by Grothuss in 1819, and he finds the general principle that colored light seeks to destroy, in bodies upon which it acts, those colors which are opposed to its own, while it endeavors to retain its own or another analogous color. By "opposed" we should understand the complementary color, that is, red rays seek to discharge the complementary blue-green and retain the red color in a body. Sir John Herschel made observations upon this fact in 1842, and since that time other scientists have been occupied with the question. The first one who proposed to utilize the principle for photographic color printing seems to have been Liesegang, in 1889. Certain aniline dyes bleach very rapidly in light if this property is to be utilized. If we mix dyes of the three primary colors, red, green and blue, we obtain black. If we produce this black upon paper by using very sensitive aniline dyes and place a colored picture upon it, blue will only remain under the blues, red under the reds, and so on. In this bleach-out process each color of the original will be reproduced in the paper and we will obtain a reproduction in the true colors or a positive direct from a positive, and not from an intermediate negative, as usual. In practice there are a number of difficulties in the way which have hitherto made researches unavailing. A printing paper in colors therefore had not as yet been produced. Dr. Smith worked upon the question for eight years and studied more than 2,000 aniline colors and their combinations. Finally he was able to bring out his new "Utocolor" paper, and its success is due mainly to the choice of the proper dyes and also to his discovery of certain bodies which act as sensitizers, so that when added to the colors they cause them to bleach out more rapidly.

The new paper has a black surface, owing to the mixing of the various dyes with which it is composed. Using an autochrome or other colored plate (or even hand-colored lantern slides, in short any transparent colored object), the plate is laid in the printing frame with the film side next the paper, and the latter is placed upon it just as in ordinary printing. The bleach-out process requires the action of a stronger light than the usual papers, and needs about two hours exposure in strong sunlight and a correspondingly longer time in diffused light. Very good results are obtained by commencing in good diffused light and printing for several hours, then finishing in sunlight for about an hour. A thick glass plate is used in the frame in order to protect the paper against heating and also to cut off most of the ultra-violet rays. Light-filters of a greenish colored glass are preferably used in order to compensate for the variations in the quality of light. Two such screens of somewhat different colors are furnished with the paper. During the printing the black color of the paper is seen to fade out, and the color tones commence to appear, so that this can be watched as is usual for printing out paper. The print is finished when it corresponds to the original plate, and after washing is then put in a special fixing bath for 15 minutes so as to remove the sensitizers and thus give a greater fixity to the image. After a short rinsing the print is put in a second bath, which serves to increase the natural stability of the colors. It only remains to rinse off and hang up to dry. The prints which Dr. Smith showed me have a very pleasing hue, and the fact that they may not have all the brilliancy of the original is perhaps not a drawback when we see that the extended tones given in this way have undoubtedly a greater artistic effect and are more pleasing to the eye.

Dr. Smith gives full directions for working the paper, so that it should be easy to manipulate by any practised photographer. Although color positives such as Autochrome, Omnicolor, Dioptichrome and Thames-color plates are the principal subject for printing, a large number of others are available such as three-color glass and film positives, hand-colored slides, transparent paper and glass paintings, colored plans and architects' or engineers' drawings on tracing paper. Good colored pictures, lithographs, etc., on ordinary paper can be made transparent by rubbing in with oil at the back. Pressed flowers and leaves, butterflies and the like, which can be pressed flat upon glass, may also be used. In any case it is preferable to use brilliant colored plates or objects to begin with than soft and delicate hues, as the paper prints always lose some of the color of the original.

Just as in usual work, strong contrast plates are to be avoided because one part is over-printed before the other is finished, so that an even lighting should be given the subject when photographing. Retouching can be readily done on the color plates so as to increase the brilliancy of the positive, and especially on large monotone color surfaces such as blue sky. This corresponds exactly to black and white retouching, and as the colors are given by the plate we need only brush over with the corresponding tone so as to heighten it. Suitable dyes supplied by the inventor must be used here. For varnishing, the special "Utocolor varnish" discovered by Dr. Smith is essential, as the usual varnishes would soften in the sun. Such varnishes must be first dissolved off with benzol. For printing, the best results are obtained under white clouds, but unfortunately this kind of illumination seldom lasts long enough. As the sun's heat is likely to overheat the plate and cause the colors to be destroyed, resulting in a black and white image, the printing must be looked after and the plate not exposed too long to the sun, cooling down at intervals. A plate glass of about half an inch is good to absorb the heat. Special frames with even thicker glass are to be put on the market with a convenient arrangement for inserting the light filters. Dr. Smith furnishes two grades of filters known as G. and M. G., and both serve to absorb the injurious ultra-violet rays. The first screen is used in strong diffused light and in weak sunlight, and the second in strong sunlight. Both together may be needed in southern climates. Although a filter is not needed in very weak light, printing should not be done by such light, or at least we should wait for sunlight in order to finish the print under the filter screen. The prints must be examined at intervals, and experience will soon show the best method of working. It may be said in general that should the print have a reddish tinge it is a sign that the green filter

used is too weak, but a green tinge means that it is too strong. This can therefore be corrected while printing. As to the fixing process, this is quite different from the ordinary. Two fixing baths are being put on the market, known as A and B. The prints are first washed for five minutes in three changes of water and then put in bath A for fifteen minutes, rocking the dish, then they are rinsed well for three minutes and laid in bath B for seven minutes, shaking as before. The operation is completed by rinsing for a few seconds under the tap, but not further washing, then hanging up to dry. Such prints should not be kept exposed to a very strong light for a long time, as the fixing, although good, is not quite perfect. But the prints may be placed in a room if only weakly illuminated for a long time without suffering, and in albums can be kept for an unlimited time.

Grafting Pecan upon Hickory

By Isaac Motes

THE grafting of pecan onto hickory is now claiming a good deal of attention from southern horticulturists. Wonders are being accomplished in this branch of nut culture, and it would seem that if pecans are ever to be grown for commercial purposes in the central and northern states they must be upon trees grafted on hardy hickory stocks. Grafted or budded pecans do best in the Gulf and South Atlantic States. There are a few seedling trees in Illinois, Missouri, and Southern Iowa, but they are not fair specimens of this king of American edible nuts, for pecan seedlings, though more hardy than grafted varieties, are much smaller and never bear true to type of mother tree, so the only way to propagate paper shell pecans is to bud or graft from an approved tree, when you get a tree which bears nuts similar to the one from which the graft was taken. These fine varieties of pecans do not succeed north of latitude 35, about that of Memphis, Tenn., and Fort Smith, Ark., for the rigorous winters seem to injure the trees, either by late spring frosts, or the early autumn frosts, which damage the thin shelled nuts before they are thoroughly ripe, while they are "in the milk."

It has been found that pecans grafted on hickory stocks stand cold better, both in the spring and autumn, and besides grow off more rapidly, and begin bearing sooner, having a well-formed root system to nourish them. It has been found that the pecan grows upon hickory stocks the same as upon seedling pecan stocks, being itself a species of hickory. The pecan is not as easily grafted as apples, peaches and the like, but an expert can succeed in making most of his grafts live, and after a pecan reaches its fourth year from the graft and has begun bearing, its chances for living are excellent.

In the Gulf coast country and the alluvial bottoms of the lower Mississippi Valley this grafting upon hickory stock is not to make the trees resistant to cold. It is only to supply them with a well-grown root system to furnish plenty of sap to enable them to grow off luxuriantly from the start, and to make them bear early, but in the North where the summers are shorter, the grafting of pecan on native shagbark hickory would also make the grafted trees more resistant to cold, so there is more necessity for adopting this method of propagating pecans in the North than in the South, and a thorough trial of this manner of grafting might mean a great deal to the states of the upper Mississippi Valley in stimulating nut culture, for the pecan is the finest of American nuts, and people who have seen only the native wild pecans sold at fifteen cents a pound have no idea of the excellence of these fine cultivated pecans. The latter never reach the retail markets, and perhaps not one northern man in a thousand ever saw a paper shell pecan. They sell at from 50 cents to a dollar a pound to the most exclusive caterers and to great ocean steamship companies, the dining car service of great railroads and to wealthy people as dessert nuts, while the finest California almonds are selling at 20 cents per pound. The crop of paper shell pecans is so small each year, and the demand so strong, that these nuts are generally sold out before the Christmas holidays.

The northern farmer who has shagbark hickories growing in his woodlot has it in his power to very greatly benefit his

State and community by experimenting with pecan on these native stocks. It is thoroughly believed by men in the south who have given most attention to pecan culture that large and well-rooted native hickory stocks guarantee hardier pecan trees than if put on pecan stocks. Of course, in more northern regions hickories should be selected for this purpose which stand in protected valleys, along the low banks of creeks and other moist places, for a pecan tree must have moisture, and it does best on soils containing some lime, and with a clay subsoil. Pecan trees are especially suited for moist river and creek bottoms, and overflowed lands, for water standing around the trees during the growing season does not seem to injure them like it does many other trees, provided the leaves are not under water, while there are probably no streams in the upper Mississippi and Missouri valleys which overflow their bottoms during October and November to interfere with the nut gathering.

If your land is level then select hickories standing on the south side of your woodlot or windbreak, and where the trees are scattering, with no others within thirty or thirty-five feet of the one grafted upon. Let them be young, vigorous trees, preferably not over six inches in diameter, with some low limbs, so the trees may be cut off above several of these limbs without going too high.

The method of grafting on hickory, or "top working" hickory with pecan, as it is called, is to cut the top off a small hickory tree or sapling from five to ten or twelve feet above the ground. This should be done in the summer or late spring, after the sap has begun to run up freely and the tree is growing luxuriantly. The scions should be dormant—that is, the buds must not have begun to swell. This is accomplished by cutting them in the latter part of winter and keeping them in cold storage, or in an atmosphere sufficiently cool to keep the buds from swelling, and yet not too dry. Summer is better for grafting than early spring, before the buds have begun to swell, for when the scion is kept dormant until summer, when the sap is rising strongly in the stock, the grafts will be much more apt to grow. As stated above, it is best to cut off the top of the hickory above several good sized limbs, for these limbs and their green leaves will help to keep the sap running strongly upward.

The grafts will be more likely to live upon young hickories than upon old ones, because their growth is stronger. They should be placed upon these stocks with great care, for while it is true that dormant pecan grafts inserted in the summer give a larger percentage of growing trees than if grafted in the early spring, you must remember that pecan is harder to graft than most other fruit trees, and the more expert the man who does the work the greater will be the number of living trees.

Two, three or four grafts should be inserted in the stub of this sawed-off hickory, the number depending upon the tree's diameter at the place sawed off. Then if the grafts live the lower limbs of the tree may be grafted to pecan the same as the stem. If they do not, live sprouts will come out below, where the tree was cut off, and several of these may be grafted upon the following spring or summer.

Also, whenever a hickory is cut down at the usual height, for firewood or for building material on the farm, water sprouts come up from the stump and roots. A half dozen of these sprouts should be allowed to grow, and they will make fine stocks upon which to graft pecan scions the following summer. Or if the tree is cut down in the very early spring, and the sprouts come up freely and grow rapidly that spring and summer, they may be grafted on in July or the first week of August after they sprout in the spring.

The stumps of old trees do not sprout as freely as those of young ones, particularly in dry regions, but they can be made to sprout with a little trouble. The lower the stumps are cut the more freely they sprout, and if you dig around an old stump a little with a pick, and throw a few buckets of water on it occasionally it will be much more apt to sprout freely. Also make a few cuts with an axe on the large roots just where they enter the ground, and the sprouts will be more apt to grow from these cut places, rather than on top of the stump.

Almost any southern nursery can sell

you pecan grafting wood in the summer or late spring, for in winter pruning of these valuable pecan trees the orchardist saves every sprig he cuts off, and either uses it himself or sells it to his trade. These cuttings are kept dormant until needed, and will, therefore, be better for grafting in August than in March, because the flow of sap in the stocks is stronger in the summer. The thinning out of grafted pecan trees when too thick, or any pruning which the trees need should be done in the latter part of winter, and all cuttings kept in an ice house, to be used in summer.

NEW BOOKS, ETC.

MONUMENTALES UND DEKORATIVES PASTELL. (A Pastel Process for Monumental and Decorative Purposes.) Von Wilhelm Ostwald. Leipzig: Akademische Verlagsgesellschaft M. B. H., 1912. 105 pp.

The name of Wilhelm Ostwald is well known to our readers. The little work before us is another proof of the remarkable versatility and breadth of view of the great German chemist and philosopher. Those who are familiar with his life and works will remember that he has achieved no small success as an amateur in the art of painting. This no doubt was the circumstance which induced him to take a professional interest in the science—the chemical *rationale*—of painting and related arts. It is a most fortunate circumstance that a chemist of his caliber should devote his energies to a subject which, unfortunately, has received but little attention from men of his type. The present volume is devoted to the discussion of the requirements which must be fulfilled by a process used in the decoration of buildings and the like if the work is to withstand modern conditions of wear and tear, and to the description of a process worked out by the author with due regard to these requirements. Ostwald begins by pointing out that these conditions are not the same as they were years ago, when wood was commonly used as a fuel. Such material in burning produced merely carbon dioxide and water vapor, which are harmless to ordinary structures and fresco paintings, statues, etc. Coal fires, on the other hand, which are burning in every house to-day produce, in addition to the above-named products, also sulphur dioxide. This has a most baneful effect upon fresco paintings, the calcium carbonate of which it attacks; a similar action is exerted upon marble and bronze statues by the sulphurous acid gas. Ostwald therefore set himself the problem of devising a new painting process suitable for indoor and outdoor wall decoration, and one which should, under modern conditions, fill the place which was occupied well enough in the old days by fresco work, now subject to the saddest deterioration, as every lover of art knows. In developing his process Ostwald collaborated with the German painter Sascha Schneider. The process, briefly described, is somewhat as follows: The first step is to prepare a suitable substratum. The exact nature of this is not very material. It may be made from ordinary lime plaster mixed with pumice. If extreme care is to be exercised to make the work absolutely permanent, the use of lime may be avoided by employing barytes or similar material instead. The main thing is to produce a surface presenting the requisite roughness for the pencils of color applied thereto to "bite." Somewhat detailed instructions are given for the proper methods of preparing both this background and the pencils themselves. These latter are made from a mixture of a suitable white filler, such as precipitated chalk, or barytes, and the proper pigments, made into a paste and molded into shapes suitable for handling. After the pastel is completely drawn it is "fixed" by means of alcoholic caseine solution, and a final protective coating of paraffine may lastly be applied. In addition to Ostwald's description of his process, the little book contains the reports from a number of noted German painters who have tried the method and found it most satisfactory. It will be interesting to hear how the works produced by Ostwald's process will withstand the test of time.

FLIES AND MOSQUITOES AS CARRIERS OF DISEASE. By William Paul Gerhard, C.E. New York: Published by the author, 39 Strong Place, Brooklyn, N. Y., 1911. Price, 25 cents net.

The pamphlet reviews the pernicious activities of flies and mosquitoes as carriers of disease, and advises farmers and householders how best to conduct an effective campaign on behalf of cleanliness and health. The papers originally appeared in the *Country Gentleman*.

INTRODUCTION TO GENERAL SCIENCE. With Experiments. By Percy E. Rowell, B.Sc. New York: The Macmillan Company, 1911. 8vo.; 302 pp. Price, 75 cents net.

Several considerations guide the author in setting out upon his task. One is that a course in general science ceases to be general when the instructor allows some pet subject to usurp more than its share of time and attention; another is that, since youth is most interested in itself and in what most intimately touches its own life, it may be well to lead it toward large and distant things by the path

of the apparently simple and matter-of-fact. In a word, the work claims to be inspirational and suggestive, rather than a system of inelastic units presented in the uniform compartments of a steel-bound box. The two hundred sections touch upon such subjects as states of matter; combustion; cooking; the sun the source of all energy; light and vision; color; the chemical engine; the theory of the aeroplane; plant life; fermentation; the life processes; food and nutrition; how to plan a house and barn; reading meters; and the manner of living. This partial list will serve to indicate the scope of the text and the diversity of the subjects with which it deals. Most of the two hundred experiments offered require but simple apparatus.

THE LIFE OF CRUSTACEA. By W. T. Calman, D.Sc. New York: The Macmillan Company, 1911. 8vo.; 289 pp., illustrated. Price, $2 net.

The average man, asked to name some types of Crustacea, will call to mind the crab, the lobster, and the shrimp. It may surprise him to learn that barnacles and woodlice are alike entitled to the same classification, and that there are thousands of species included in this important group. The very diverse forms and characteristics of the members of the group make it a fascinating study, and the volume in hand is written for the beginner who has little or no knowledge of technical terms. The work resolves itself into a straightforward account of some important scientific problems suggested by the habits of Crustacea in their native haunts. Illustrations abound, many appearing by permission of the trustees of the British Museum, others being reproductions from photographs, and still others having been drawn from nature by a skilled artist. An appendix gives methods of collecting and preserving, and a list of general works is given for the benefit of the reader who would pursue the subject further.

PEOPLE OF THE WILD. By F. St. Mars. New York: Outing Publishing Company, 1911. 8vo.; 261 pp.; illustrated. Price, $1.25 net.

"People of the Wild" is animal life masquerading in the garb of melodrama. This method of presenting the subject is vividly impressionistic, carrying with it an enormous gain in popular appeal. The lights are unnaturally high, the shadows of the deepest black, but there can be no disputing the journalistic cleverness with which the writer has projected into birds and animals those moral and intellectual qualities, those quips and turns of imagination, rascality and pathos, that are generally usurped by man. This method has its drawbacks. For example, the tyro may read twenty pages concerning the Downy One, that brigand of the Ghost Tower, before he can be absolutely sure that he is hearing of the common magpie. After all, though, it is a gripping bit of writing, the words of which bite like the bob-cats they describe, and the writer has a way of putting things that will win him a large audience.

COMMON SENSE DIET FOR COMMON SENSE PEOPLE. By B. H. Jones. Pittsburgh, Pa.: B. H. Jones, 1911. 12mo.; 113 pp.

B. H. Jones disposes of many complex subjects with a lordly wave of the hand. He is inclined to indulge rather immoderately in such bombast as "I challenge the world of medicine and medical practitioners." However, his dietary teachings are not revolutionary, and follow closely those of the "physical culture" and "natural cure" cults. Briefly put, Mr. Jones holds that heat- and energy-producing foods consumed in excess of bodily needs results in actual loss of heat and energy; that drinks having a distinct food value—"surcharged drinks" such as milk, cocoa, etc.—introduce unsalivated food into the stomach, and cause indigestion; but that all food is good, at the right time, in right quantities, and in right combinations. It is these times, quantities and combinations that the author endeavors to arrange for us, or rather he seeks to impart that knowledge which will enable each reader to make these determinations for himself.

HÜTTE DES BAUINGENIEURS. Herausgegeben vom Akademischen Verein Hütte, E. V. Sonderausgabe des III. Bandes der "Hütte" des Ingenieurs Taschenbuch. 21. Auflage. Berlin: Wilhelm Ernst & Sohn, 1911. 8vo.; 1153 pp. Illustrated.

The main divisions of the volume are: Vermessungskunde. Statik der Baukonstruktionen. Grundbau. Eisenbetonbau. Hochbau. Lüftung und Heizung. Fabrikanlagen. Baumaschinen. Wasserbau. Wasserkraftanlagen. Strafsenbau. Städtebau. Wassersorgung. Städteentwässerung. Eisenbahnwesen. Brückenbau. These division-headings will give some idea of the scope of the work which, with the aid of fine print and well-nigh microscopic diagrams, manages to open up a mine of principle and practice within the space afforded by its thousand-odd pages.

ENTELGENE SPUREN GOETHES. Goethe's relation to mathematics, physics, chemistry and their application to the industrial arts, to technical instruction and patent practice. Expounded by Max Geitel. Munich and Berlin: R. Oldenbourg, 1911. With 35 illustrations. Price, bound, 6 marks.

Notes and Queries.

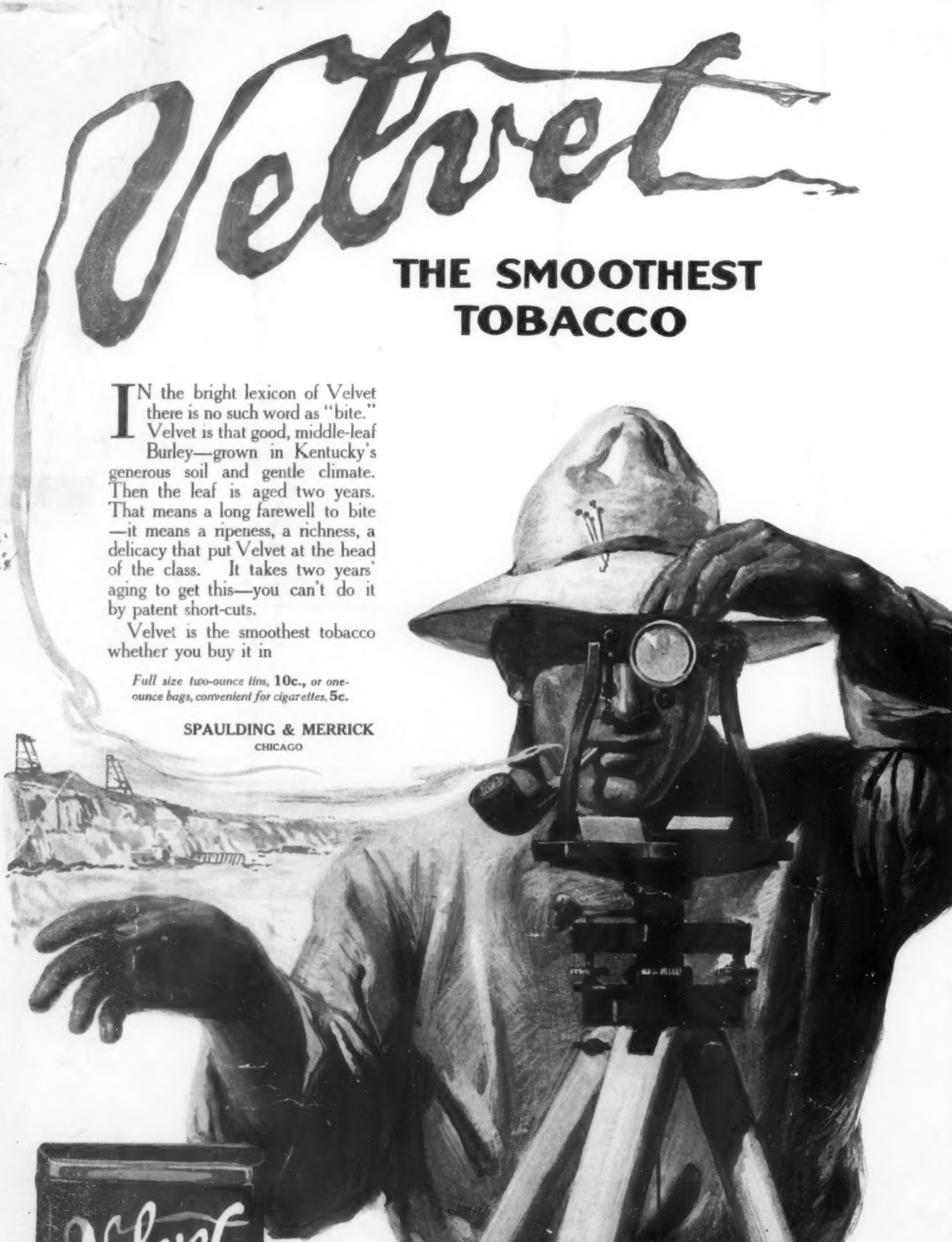
Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12601) **E. C. H. says:** I understand that there is a difference in the position of the engine in the monoplane and in the biplane. I also understand that an aviator is safer in one of these machines, on account of this difference of the location of the engine. Is this true? If so, will you kindly state in your query column what this difference is, and in which machine the aviator is safer? A. The motor is generally at the back of the main planes on a biplane if it is a Gnome. Otherwise it is more to the front but behind the aviator. A monoplane, as a rule, has the motor at the front end of the body, with a tractor screw that pulls the machine along instead of pushing it. The aviator sits back of the motor in the body, which is of course a safer position. Some of the French biplanes are now adopting the monoplane body with motor in front, as you can see in our issue of January 20th.

(12602) **T. L. asks:** Kindly answer the following questions: Which has the greater specific gravity—wet or dry snow? Do they both fall with the same velocity? A. Snow is frozen moisture from the air. It has the same specific gravity as ice, which is from 0.88 to 0.92. The latest determinations give the density of ice as 0.9168. Wet snow is snow mixed with water. The snow part is lighter than the water which adheres to the snow or accompanies it in its fall. Water has a higher specific gravity than snow, so that wet snow has a greater density than dry snow, which contains no water, but is completely frozen. If denser it will fall through the air faster, since the air cannot buoy it up so much. Dry snow is usually blown about by the wind, up and down, very easily; wet snow not so easily.

(12603) **J. M. H. asks:** I shall be greatly obliged for an explanation of the following phenomenon if you will be kind enough to give me one. At 10:05 P. M. on January 14th at Hazelhurst, Miss., I observed what was apparently a fall of sleet, lasting perhaps two or three minutes, coming from a sky absolutely clear except for horizon haze. There was no moon (moon rose about 3 A. M.) and stars were moderately brilliant. There had been no precipitation for over 72 hours, and atmospheric humidity was no higher than usual. Temperature was stationary at between 25 and 30 deg. Fahr. There were no factories, passing trains, or other possible sources of vapor at the time. The nearest body of water was a small artificial lake one-half mile distant. The following morning I observed the fall of the night before still on the ground—a few grains of apparently normally formed fine sleet. A. Such a phenomenon as you describe could only occur when the lower air was very nearly saturated with moisture; and yet the upper air was dry so that no cloud formed there. It is like the fog and dew of evening when the air is warmer. But as the thermometer was well below freezing, water drops could not form. Ice crystals formed in place of water drops, and fell to the earth. Snow is usually formed in this way in higher layers of the air, and the crystals increasing by the addition of other crystals become the snow flakes. Had the temperature been above freezing you would doubtless have had a plentiful formation of dew, perhaps a fog, lying low upon the ground, but not extending high into the air. We have often seen this in cold weather in the North, when the air would sparkle in the early sunlight of the morning with the ice crystals which it contained.

(12604) **C. P. W. writes:** You seem to have overlooked an obvious error in the letter of J. F., Query 12594, where he says, "I find the sun rose on the 21st of March at 5 o'clock and 56 minutes, and set at 6 o'clock and 4 minutes, making the day just 12 hours long." Taking these figures as given, it is plain that the forenoon was 6 hours and 4 minutes long, since the sun rose 4 minutes before 6, and the day was therefore 12 hours and 8 minutes, from sunrise to sunset. A. You are right. At least we overlooked the error in our first reading, and only saw it too late for insertion in our answer. We did not expect such a mistake in a letter claiming an error on our part. The query as printed makes it clear why the day from sunrise to sunset, as given in almanacs, is more than 12 hours long at the vernal equinox. The time given above must be taken with reference to true noon, or midday, and not to mean noon, or noon by Eastern standard time. By Eastern standard time the sun does not rise at 5 hours 56 minutes and set at 6 hours and 4 minutes on March 21st, but the afternoon is several minutes longer than the forenoon. According to two calendars lying before us, the sun rises by Eastern standard time on March 21st at 6 hours 2 minutes and sets at 6 hours 13 minutes.


Velvet
THE SMOOTHEST TOBACCO
IN the bright lexicon of Velvet there is no such word as "bite." Velvet is that good, middle-leaf Burley—grown in Kentucky's generous soil and gentle climate. Then the leaf is aged two years. That means a long farewell to bite—it means a ripeness, a richness, a delicacy that put Velvet at the head of the class. It takes two years' aging to get this—you can't do it by patent short-cuts.
Velvet is the smoothest tobacco whether you buy it in
Full size two-ounce tins, 10c., or one-ounce bags, convenient for cigarettes, 5c.
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